The 75-mm. Field Gun, Model 1916 MIII

American Machinist

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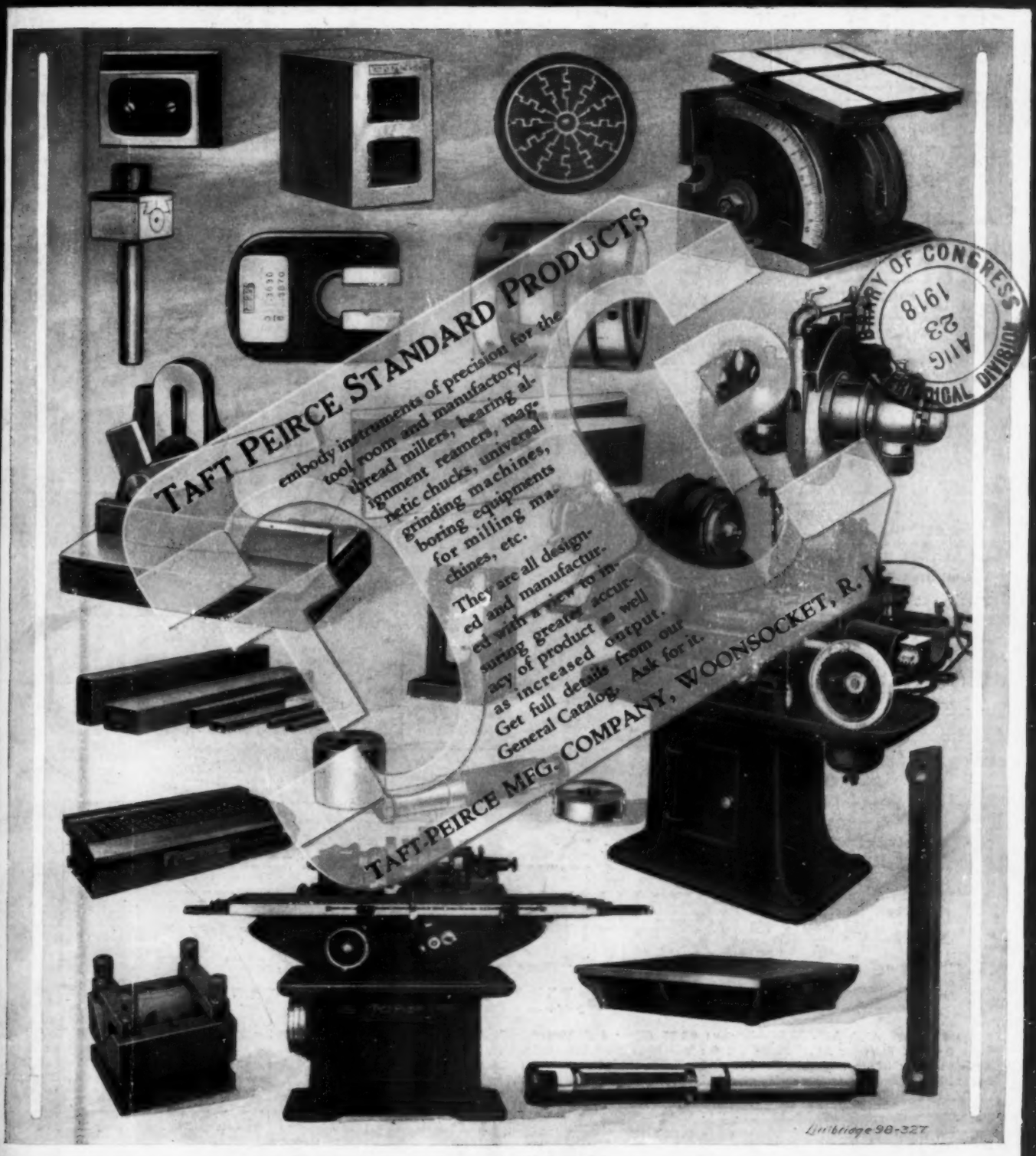

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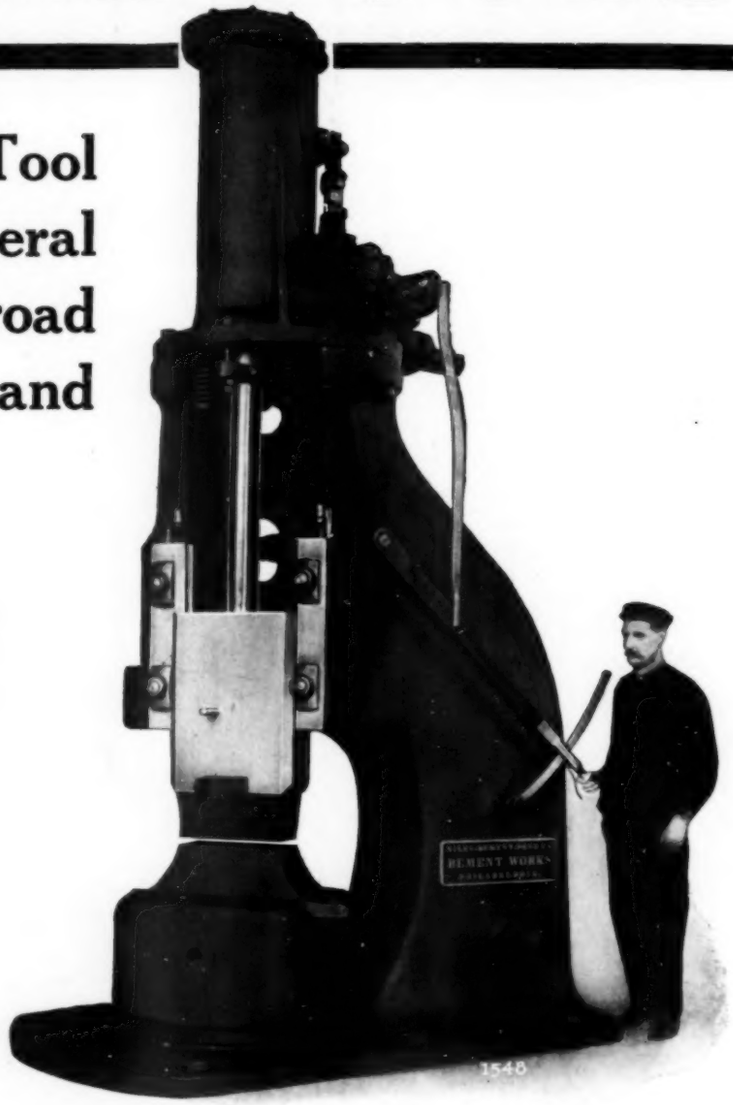

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American Machinist

FRED H. COLVIN, *Editor*

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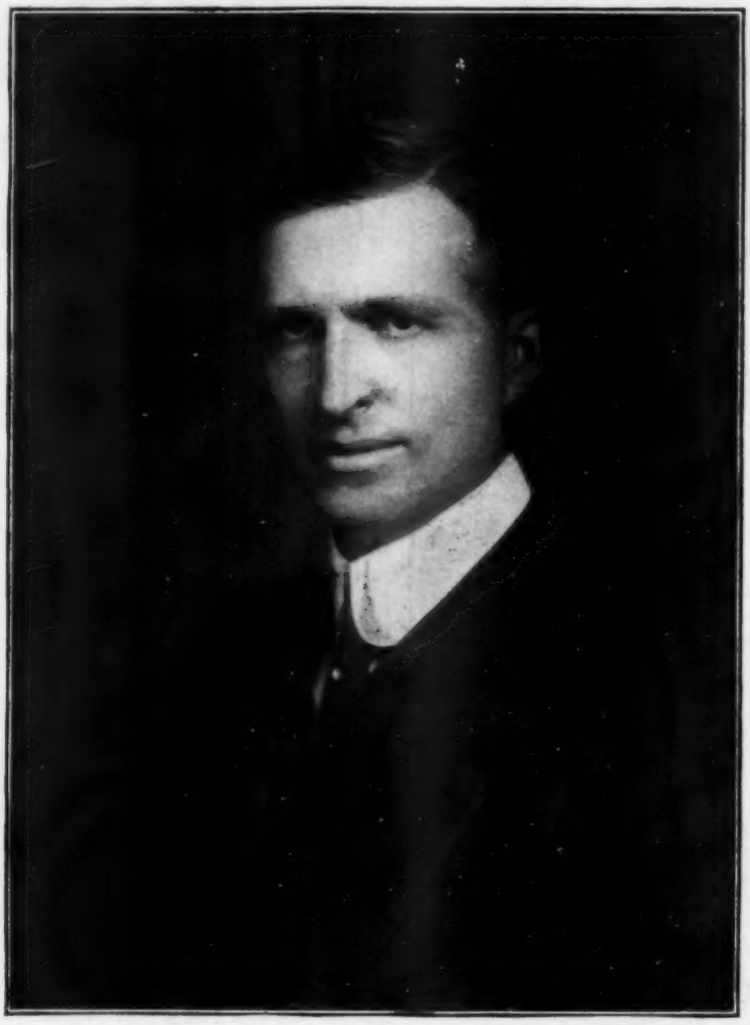


MR. FREDERICK H. PAYNE

IT IS refreshing to see a man who is a booster for his town, when that town is a small place and the man has lived in large cities, but one cannot talk with Mr. Frederick H. Payne, vice president and general manager of the Greenfield Tap and Die Corporation, very long without realizing that Greenfield is the beautiful town that it is.

He was born there on Nov. 10, 1876. He went to the public schools there, and during his first fourteen years of business life occupied various positions in the First National Bank.

In 1906, however, he resigned as teller to become bank examiner for the State of Massachusetts. In 1909 he was elected president of the Mechanics Trust Co., Boston, he then being the youngest bank president in the State of Massachusetts. Later this trust company was consolidated with the Federal Trust Co., of Boston, and Mr. Payne became first vice president.

On Apr. 2, 1912, the Greenfield Tap and Die Corporation was organized, and he became treasurer. For the past two years he has been vice president and general manager, and in addition he is now president of the Lincoln Twist Drill Co., Taunton; director of the Blevney Machine Co., Greenfield; director of the Federal Trust Co., Boston, director of the First National Bank, Greenfield, and trustee of the Franklin Savings Institution, Greenfield. He is a member of the Hardware Club, New York; Colony Club, Springfield; Greenfield Club, Greenfield, and the Country Club of Greenfield.

He says that he has no hobby, except work, but it is really this—to weld the industries of Greenfield together as closely as possible, so that the industries will grow, Greenfield will grow, and Greenfield will be a good place to live and work in.

August 22, 1918 American Machinist Vol. 49, No. 8

The 75-Mm. Field Gun

Model 1916, M.III

Special Correspondence

Four types of 75-mm. field guns have been built by the United States Government. This article describes the latest of these types, giving length, weight and other data. The component parts of the breech-closing and firing mechanism are illustrated and described and complete directions are given for assembling and disassembling.

THIS is the latest modification of the 75-mm. gun, the changes affecting the operating mechanism only. It is built up of nickel-steel forgings, consisting of a tube, jacket, breech ring and clip hoop, as shown in Fig. 1. All of the parts are assembled by shrinking. In describing this gun the terms right and left, front and rear, etc., refer to the location of the assembled parts, and front is the direction in which the muzzle of the gun points. For the purpose of brevity in description the gun is assumed to lie with the axis of the operating shaft horizontal. The tube carries a shoulder at its rear end, which prevents motion of the jacket, and a shoulder near the muzzle end against which the clip is assembled. The tube terminates at the rear end of the powder chamber, and there are two recesses cut in its rear face to form seats for the lips of the extractors.

THE 75-MM. FIELD GUN, MODEL 1916, MIII
WEIGHTS, DIMENSIONS, ETC.

Weight	749 lb.
Caliber	2.953 in. (75 mm.)
Total length	90.9 in. (2308.86 mm.)
Length of bore	84 in. (2133.6 mm.)
Length of rifled portion of bore	72.72 in. (1847.1 mm.)
Number of grooves	24
Width of grooves	.2874 in. (7.3 mm.)
Depth of grooves	0.02 in. (6.508 mm.)
Width of lands	.0992 in. (2.52 mm.)

Twist right hand, zero turns from origin to point 2.89 in. from origin. Increasing from one turn in 119 calibers at a point 2.89 in. from origin to one turn in 25.4 calibers at a point 9.72 in. from muzzle. Constant from latter point to muzzle.

Weight of Projectiles:	
Shrapnel	15.96 lb.
Shell	12.36 lb.
Weight of charge	26 oz.
Service pressure per square inch	33,000 lb.

The jacket is assembled over the muzzle end of the tube. The jacket carries two flanges on its lower side, which form part of the guide rails of the gun, and a lug on top near the forward end contains a T-slot which holds the oil cylinder in place. The rear end of the jacket is threaded on the outside to receive the breech hoop.

The breech ring is threaded at its forward end and screws onto the rear of the jacket. A shoulder in the breech ring abuts against the rear of the tube. The breech ring carries a recoil lug at the top for the attachment of the hydraulic recoil abutments and another lug at the bottom for attachment of the two spring piston rods. The breech ring is cut away to form the rectangular breech recess with its longer axis vertical and its front face flush with the end of the tube, leaving the metal at the rear to support the block against the powder-chamber pressure at the time of discharge.

The clip is a short hoop shrunk on the tube near the muzzle. It carries two lugs on its under side, which form the ends of the recoil slide.

The recoil slides are two lugs with parallel surfaces, top and bottom, extending the entire length of the jacket and clip. They fit into corresponding grooves or clips in the cradle and serve to guide the gun in recoil. The rear ends of the recoil slides on the jacket are extended to the face of the recoil lugs by short extensions riveted in place to prevent entrance of dust between surfaces of recoil slides and clips. For the same purpose the forward ends of the guide rails on the clips are connected by steel-plate dust guards with the rear ends of the guide rails on the clip.

The mechanism is known as the drop-block type, and is semiautomatic in design in that the block closes automatically when a round of ammunition is inserted. A rectangular hole (with its longer axis vertical) slotted through the rectangular section of the breech hoop and with its front face flush with the end of the powder chamber forms a seat for the sliding block. The upper part of the breech hoop in the rear of this slot is cut away, leaving a U-shaped opening which allows the passage of the cartridge case and completes the breech recess. A cylindrical recess at right angles to the axis of the gun passing through the upper part of the lower recoil lugs forms a seat for the operating shaft. Recesses cut in both of the side faces of the breech recess form seats for trunnions on the two extractors, and holes bored into these recesses from the rear face form seats for the extractor plungers, springs and plugs. The block slides up and down in the breech recess under the action of the operating arm, which is pivoted on the operating shaft, and acts as an oscillating crank in raising and lowering the block. The operating shaft, which rotates the operating arm, is rotated by the operating handle. The operating handle is provided with a latch to keep it in the closed position, and is connected by a chain, piston rod and piston to the closing spring, which is carried in the closing-spring case. The closing spring is under compression and tends to keep the block closed or to close the block when it is open.

When the block is opened as far as it will go it is locked in that position by the inside trunnions on the extractors, which are forced over horizontal shoulders

on the block by the extractor plungers and hold the block in that position until the rim on the next cartridge striking against the lips on the extractors frees the trunnions from the shoulders on the block and allows the block to close under the action of the closing spring.

A continuous pull-firing mechanism is carried in the recess bored out in the center of the block and is operated by the trigger shaft which projects from the bottom of the block. The mechanism is cocked and fired by one continuous motion of the trigger shaft, so that in case of misfire the primer may be struck a second blow by releasing the trigger shaft and then rotating it again. The mechanism is designed to be fired either by a firing shaft and handle carried on the cradle of the gun carriage, the firing shaft engaging with the projecting end of the trigger shaft, or by means of a lanyard. A hole

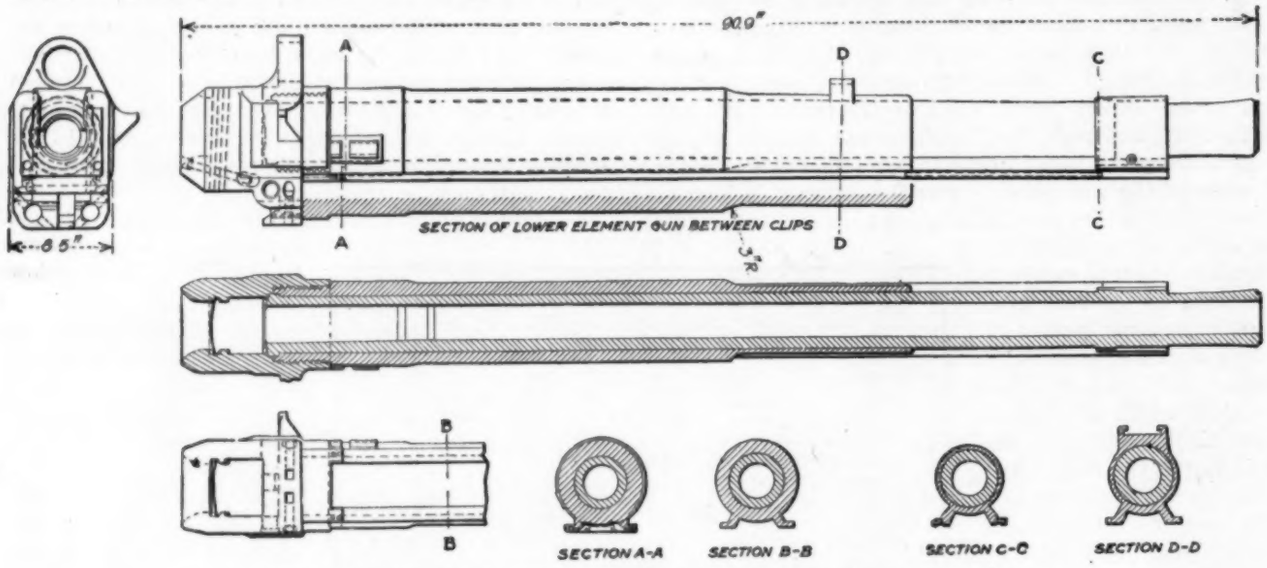


FIG. 1. GENERAL DRAWING OF THE 75-MM. FIELD GUN, MODEL 1916

for attaching the lanyard is provided in the projecting end of the trigger shaft.

The Breech Block.—The breech block *A*, Fig. 2, consists of a rectangular block of forged steel carrying two flanges on either side which engage the corresponding grooves in the breech recess and lock the block to the gun. These flanges and slots are inclined at a slight angle to the vertical, so that the block moves forward slightly in closing and forces the cartridge into its seat. The upper part of the block is cut away in a circular opening to permit the passage of the cartridge when the block is open. The front edge of this opening is beveled off so that if the cartridge is not seated when the block is closed this bevel will strike the edge of the cartridge case and push it home. A slot inclined at an angle to the front face of the block and having a T-shaped cross-section is contained in the lower part of the block. The T-shaped outer end of the operating arm works in this slot in raising and lowering the block. A slot in each of the side faces of the block forms a guide for the inside trunnion of the extractor on that side. The lower part of this slot is inclined slightly forward and the upper part curves sharply to the front, thus increasing the speed of extraction during the final part of the downward motion of the block. The lug at the front of this slot is cut away at its upper end to form a horizontal surface, and the inner trunnions on the extractors are forced over this surface by the extractor plungers so as to lock the block in its open position. The firing-mechanism recess consists of a hole bored through the center of the block from the rear face to the front face and counterbored out to the shape of the firing pin, a larger bore at the rear end of this hole which is threaded to receive the faceplate, a rectangular slot opening into one side of the firing-pin hole which receives the hub of the firing arm, a long cylindrical hole extending from the bottom of the block through the above slot for the trigger shaft and a cylindrical hole from the left face of the block to the firing-pin hole for the sear and sear spring. This last hole is threaded at its outer end for the sear-spring seat and breaks through the front end of the firing-arm slot. A V-shaped recess in the lower face of the block with the apex at the trigger-shaft hole limits the amount of rotation of the trigger shaft and protects the firing mechanism from damage.

The Operating Arm.—The operating arm *B*, Fig. 2, is a steel drop forging with a cylindrical hub, one end of which is bored and slotted to fit the operating shaft, and at the other end a T-shaped head which operates in the corresponding slot of the breech block. The exterior of the hub on the operating arm fits the recess in the breech end of the gun in which it rotates and serves to relieve the operating shaft from the weight of the block. The operating arm oscillates about the axis of the operating shaft and acts as a crank in raising and lowering the block. The lower surface of the arm projecting from the lug bears against the projecting lug on the gun and stops the block when it has reached the open position.

The Operating Shaft.—The operating shaft *C*, Fig. 2, is forged steel with a cylindrical flange at its left end, which bears in the counterbored recess in the left side of the breech end of the gun and locates the shaft when it is inserted. A short section of the shaft to the right of this is cylindrical and fits the bore in the breech end of the gun. The remainder of the shaft is supported in the bore by the hubs on the operating arms and operating handle into which it fits. The shaft to the right of this cylindrical section is irregular in shape, the cross-section having four sides of a hexagon and the remainder

the arc of a circle whose diameter is the outside diameter of the hexagon. The hexagon part is to prevent the shaft turning in the operating arm and the operating handle which is slotted to fit it, and the round part is to prevent the shaft from being assembled in any but the proper position. At the right end of the shaft a small groove is cut to receive the forked end of the operating shaft detent *F*, Fig. 2.

The Operating Handle.—The operating handle *D*, Fig. 3, carries a conical grip at its upper end. Fitting into this grip is the lever of the handle latch, which is pivoted at the bottom of the grip by the latch pivot. The latch spring is located at the upper end of the slot in the grip and keeps the latch lever projecting beyond the surface of the grip until the handle is grasped when the lever is forced into the slot, withdrawing the latch and releasing the handle. Below the grip is a lug for attaching the chain, and below that another lug which forms a bearing for the chain when the block is open. At the bottom of the handle is a cylindrical hub shaped on the

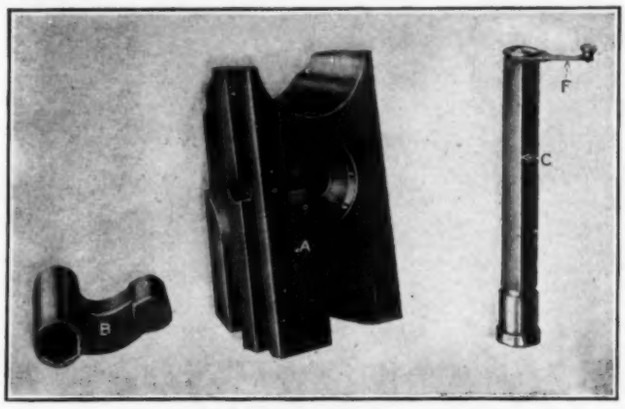


FIG. 2. BREECH BLOCK, OPERATING ARM AND OPERATING SHAFT

inside to fit the end of the operating shaft and on the outside to fit the cylindrical recess in the gun in which it rotates. A small conical hole in the right face forms a seat for the pin on the operating-shaft detent.

The Extractors.—The extractors *E*, Fig. 3, of which there are two (right and left), are flat, oblong steel drop-forgings. From each extractor there are three projections: First, a lip at the front part of the upper end of the extractor, which fits into the recess in the tube and bears against the front face of the flange on the cartridge case in extracting the case; second, a trunnion on the outside of the lower portion of the extractor, which moves in a recess in the wall of the breech recess and against which the extractor plunger bears, (this plunger, which together with the plunger spring and plunger plug is carried in a cylindrical hole in the breech hoop, tends to push the lower part of the extractor forward, and has for its principal purpose the forcing of the inside trunnion on the extractor over the horizontal shoulder on the block in order to lock the block in the open position); third, a trunnion on the inside of the lever portion of the extractor. This trunnion operates in the cam slot in the side face of the block and imparts a rolling motion to the extractor. A flat is cut on this trunnion to engage with the corresponding horizontal shoulder on the block in locking the block open.

The front surface of the extractor is curved, and as the block is opened the lower end of the extractor is forced forward by the trunnion, which fits in the inclined groove on the block, and the extractor rolls on this curved surface, which bears against the vertical surface on the gun at the rear of the tube. By this method a variable leverage is obtained, giving the greater power and less speed at the first part of the extraction and greater speed and less power at the final part of the extraction.

The Operating Shaft Detent.—The operating-shaft detent *F*, Fig. 2, is a Y-shaped flat steel spring. The forks of this detent fit into the groove at the right end of the operating shaft and on the outside of the operating-handle hub. At the upper end of the detent is a conical pin which snaps into a hole in the handle, thus locking the detent in place.

NOMENCLATURE OF THE BREECH MECHANISM, FIGS. 2, 3 AND 4

Quantity	Marks	Name of Part	Location
1	A	Breech block	In breech recess
1	T	Face plate	Closes firing-mechanism recess
1	S	Firing pin	In firing-mechanism recess
1	R	Firing spring	In firing pin
1	J	Firing-spring shoe	In firing pin
1	K	Firing arm	In firing-mechanism recess
1	L	Sear	In firing-mechanism recess
1	U	Sear spring	In firing-mechanism recess
1	..	Sear spring seat (not shown)	Inclosed hole bored for sear
1	M	Trigger shaft	In recess in block
1	W	Trigger-shaft detent and spin	Secures trigger shaft in block
2	E	Extractors (right and left)	In breech recess
2	Q	Extractor plungers	In extractor plunger holes in breech end
2	O	Extractor plunger springs	In extractor-plunger holes in breech end
2	P	Plunger plugs	In extractor-plunger holes in breech end
1	C	Operating shaft	In recess in lower part of breech end
1	B	Operating arm	Pivoted on operating shaft
1	D	Operating handle	On right end of operating shaft
1	F	Operating-shaft detent	Holds operating handle on operating shaft
1	D1	Operating-handle latch	Latches handle in closed position
1	D2	Operating-handle latch spring	In operating handle
1	D3	Operating-handle latch pivot	Pivots latch in operating handle
1	..	Operating-handle latch catch (not shown)	Fastened to right side of breech end
3	..	Operating-handle latch catch screws (not shown)	Secures catch to breech end
1	G	Closing spring case	Dovetailed to right side of jacket
1	I	Closing spring	In closing spring case
1	H1	Closing spring piston	At front end of closing spring
1	H	Closing-spring piston rod	Connects spring piston and chain
1	H2	Closing spring piston-rod nut	On piston rod
1	H2	Locknut	Holds piston rod in place
1	H3	Chain	Connects piston rod and operating handle
1	V	Closing-spring case key	Secures case to jacket
2	H4	Stud-link pins	Secure chain to piston rod and operating handle
1	N	Return catch	Pivoted on left side of breech end
1	N1	Return-catch spring	In return catch
1	Z	Return-catch pin	Pivots return catch
1	Y	Return-catch pin washer	On pin
1	X	Return-catch stop	Screwed into left side of breech end

The Closing-Spring Case.—The closing-spring case *G*, Fig. 3 is a cylindrical-hollow steel casting with a lug on one side in which there is a dovetail slot to fit over a corresponding lug on the right side of the gun. A rectangular slot at right angles to the dovetail passing through the case and the lug on the gun is provided for the insertion of a rectangular key having a taper on one side, the insertion of which forces the case into position and locks it there. The case is bored out to receive the closing spring, and a shoulder is left at the rear end against which the end of the spring bears.

Spring Piston Rod.—The closing-spring piston rod *H*, Fig. 3, passes through the center of the spring *I*, carrying at its front end the spring follower H_1 which is held in place by the spring piston nut H_2. This rod is connected at its rear end to the chain terminal, which furnishes a flexible connection between it and the operating handle as shown.

The Closing Spring.—The closing spring *I* is a helical coiled push spring. It is compressed to 14 in. at assembled height when the block is closed and exerts a pressure of 14 lb. The pressure may be increased to the amount necessary to insure the closing of the block by screwing up on the piston-rod nut, but should not be increased to a greater amount than is necessary to attain this result, as excessive compression of the spring causes the handle to batter up the stop in closing and may cause the spring to take a set. When the block is opened, the spring is compressed by an additional amount of 5.05 in. and should exert a force of 290 lb.

The Firing Pin.—The firing pin *S*, Fig. 4, is a hollow cylinder, carrying on its front end a smaller solid cylinder terminating in a conical point which, when in its forward position, protrudes through the front face of

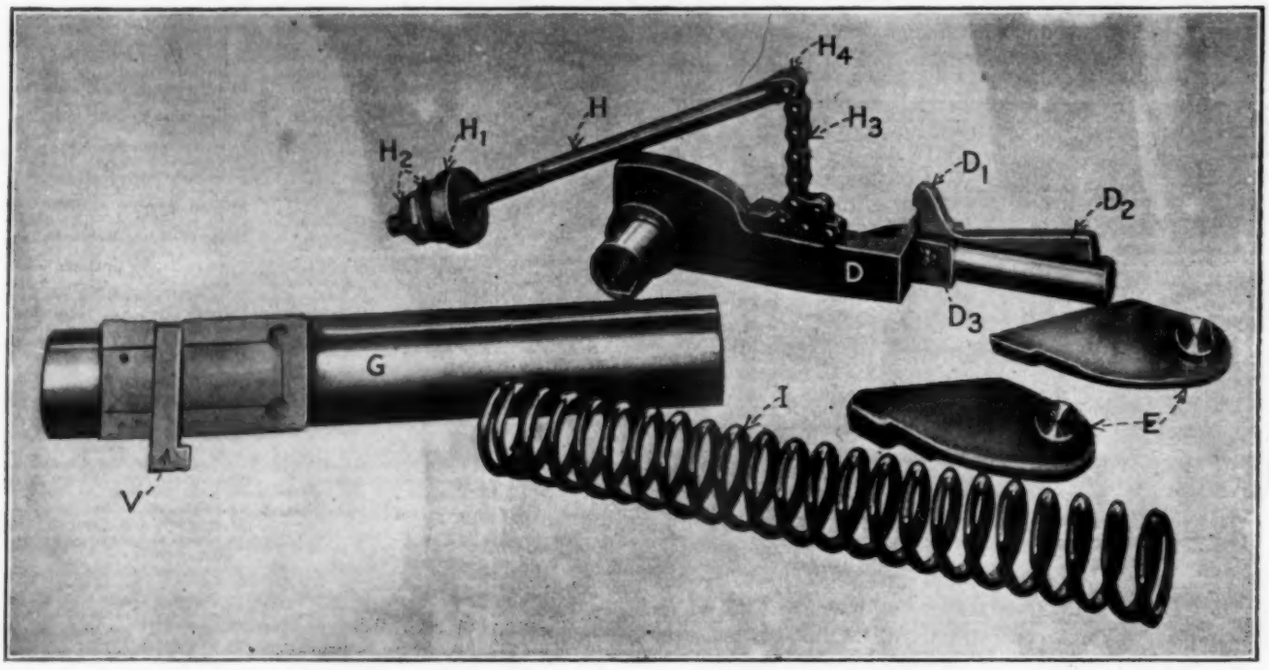


FIG. 3. OPERATING HANDLE, EXTRACTORS AND CLOSING MECHANISM

block and indents the cap in firing. Two slots are cut on one side of the firing pin, one to receive the projection on the sear *L*, which engages the rear edge of the slot and holds the pin back until the sear is released by the action of the firing arm. The other slot admits the end of the firing arm *K*, which passes through and bears on the rear of the spring follower. The rear end of this slot bears against the back of the firing arm when the pin is being returned to the rear position under the action of this arm. On the opposite side of the pin is a small slot into which the pin on the shoe *J* fits. This slot is provided with two right-angled turns which form a shoulder and lock the shoe in the firing pin until it is released by being rotated.

The bearing surfaces on the exterior of the firing pin have grooves cut in them to prevent the formation of an air cushion in the front of the pin.

The Spring Shoe.—The spring shoe *J* is a hollow cylinder which fits over the rear of the firing spring *R* and slides inside the firing pin. A lug on the exterior of the shoe engages in a slot in the firing pin, and when rotated in position prevents the shoe from being forced out by the spring. At the rear of the shoe is a slot into which the end of the firing arm fits.

The Firing Arm.—The firing arm *K* is a steel drop-forging consisting of a cylindrical hub with a projecting arm carrying a small knob at its outer end. The hub is provided with a square hole. The firing arm fits in a slot in the block and the square hole fits over a corresponding square on the trigger shaft by which the arm is rotated. The outer end of the arm passes through the wall of the firing pin, and the knob bears on the surface at the forward end of the slot in the spring shoe. The firing arm also carries a small projecting shoulder which engages a corresponding shoulder on the sear when the arm is rotated to the proper position and releases the sear from the firing pin.

The Sear.—The sear *L* is a small steel cylinder open at one end to receive the sear spring *U*. It carries a projecting shoulder which engages in the notch in the firing pin and a second shoulder on which the shoulder on the firing arm operates in releasing the sear. The sear and sear spring are carried in a cylindrical recess in the block which opens into the hole containing the firing pin.

The Trigger Shaft.—The trigger shaft *M* is a cylindrical shaft carrying a square on one side, which fits into the firing shaft, and a flat arm projecting at right angles from the other end, which serves to rotate the shaft. This arm carries at its outer end a bearing surface, the firing shaft and a hole for the lanyard.

The Return Catch.—The return catch *N* is pivoted on the left side of the breech end of the gun, and when the gun is out of battery it is held down by its weight and the action of the catch spring, which bears against the under side of the return catch stop. When the return catch is in the downward position the hook on its end is in line with a notch in the end of the firing shaft. If the firing shaft is moved to the rear when the gun is out of battery it will be caught by this catch, which

prevents firing of the piece. When the gun is in battery the hook on the catch is lifted out of line with the notch in the firing shaft by a cam mounted on the firing-shaft bracket.

To Open the Block.—The operating handle is grasped around the grip and the pressure of the fingers releases the latch. The handle axis rotates to the rear approximately 90 deg., compressing the closing spring and rotating the operating shaft. The rotating operating shaft rotates the operating arm and as the outer end of the arm moves downward it allows the block to slide downward in the recess. This movement continues until the lower surface of the projecting part of the operating arm comes in contact with a lug provided for that purpose at the bottom part of the breech end of the gun. During the downward movement of the block the inshaft is forced to the rear either by the firing shaft on the cradle or by the lanyard, and the trigger shaft is rotated. The firing arm which is carried on the square portion of the trigger shaft is rotated and the outer end bearing against the rear of the spring shoe causes it to move forward, compressing the spring until the projecting shoulder on the firing arm engages a corresponding shoulder on the sear and disengages the latter from the firing pin, when the pin is thrown forward under compression of the spring, firing the piece. After the pin has gone forward, the firing spring is still under the initial compression. The pressure of the firing spring is conveyed to the front side of the firing arm by means of the spring shoe, and the same pressure is conveyed to the rear of the firing arm by the rear edge of the slot in the pin through which the firing arm projects.

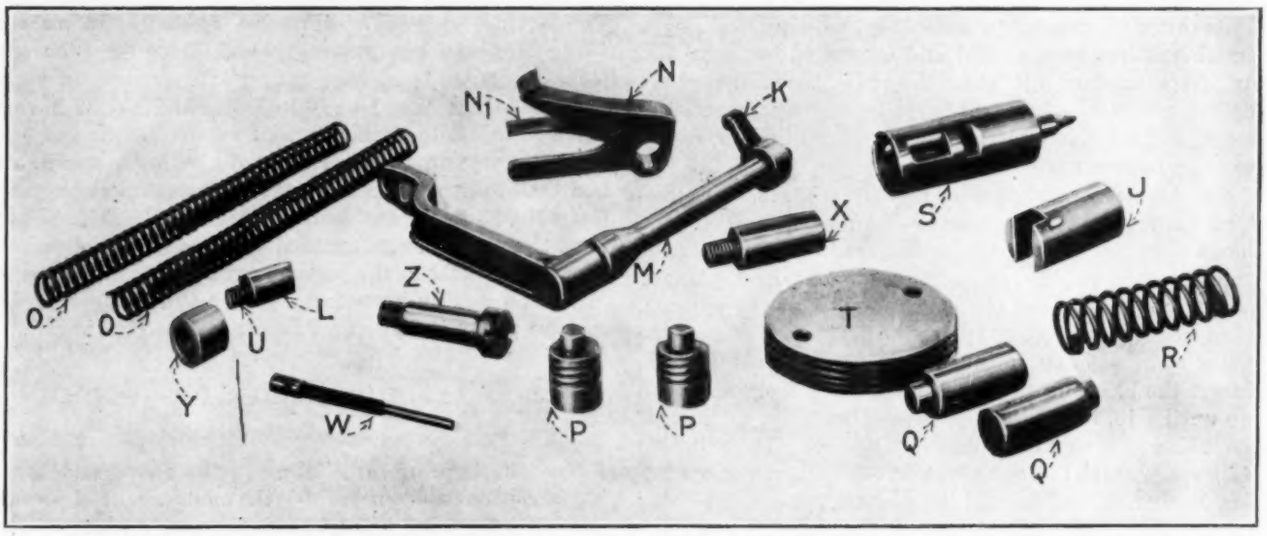


FIG. 4. SMALLER PARTS OF THE BREECH MECHANISM

clined grooves on its sides force the extractor trunnions forward and rotate the lips of the extractors away from the end of the tube, thus extracting the cartridge case. When the block reaches the limit of its downward motion the extractor trunnions come opposite the point where the lugs forming the front sides of the grooves in which they move are cut away and are forced over the horizontal surfaces at the top of the lugs by the extractor plungers, thus locking the block open.

To Close the Block.—A round of ammunition is inserted smartly and the flange on the cartridge case catches on the lips of the extractors and rotates the lower parts which carry the trunnions to the rear, disengaging the trunnions from the locking surfaces. As the block is no longer locked down the pull on the chain terminal exerted by the closing spring causes the operating handle to rotate upward, carrying with it the operating shaft and operating arm, which raises the block. These parts move with increasing velocity until the operating arm reaches a point where it is approximately at dead center with respect to the motion of the block, so that the upward motion of the block is reduced gradually. The rotating parts are brought to rest by the striking of a bearing surface on the operating handle against a corresponding surface on the operating-latch catch and the block is locked in the closed position.

To Fire the Piece.—The projecting end of the trigger

These two pressures are equal and opposite and would tend to rotate the firing arm about a point halfway between their points of application, but the firing arm is pivoted on the trigger shaft and can rotate about the center of the shaft only. Therefore as the pressure applied by the spring shoe has the greater lever arm the firing arm is rotated about the center of the trigger shaft and carries the pin back until the sear engages in its slot and the mechanism is ready to be fired again.

To Disassemble.—Remove trigger-shaft detent pin and trigger shaft. Remove the operating-shaft detent by pulling its upper end to the right until the small pin is released from its seat, then rotate it to the rear until it comes clear of the operating shaft. Disconnect the closing chain from the operating handle by removing the small connecting pin. Remove the operating handle from the operating shaft. After the operating handle is removed the block must be held in place. Remove the operating shaft by pulling it out to left. Push up on the block until it is ¼ in. above its closed position when the hub on the operating arm will clear the edge of the recess in the gun in which it fits, and the arm may be removed. Allow the block to slide downward until it clears the breech recess when it may be removed. Withdraw the pin which holds the closing spring case on its seat and push the case off to the front. The closing spring, piston and chain terminal can be withdrawn from the case. The extractor

plunger and springs may be removed by unscrewing the two plunger plugs, but care must be used to prevent these plugs from being thrown to the rear when the threads disengage. A screwdriver is required for this purpose. The disassembling may be done either when the block is mounted or dismounted.

To disassemble the firing mechanism remove trigger-shaft detent pin and trigger shaft, unscrew the closing cap with a tit wrench and pull firing mechanism out with the fingers. Remove firing arm. Insert flat end of trigger shaft in slot in spring shoe, push down and turn clockwise to disengage the pin on the shoe from the shoulder in the slot in the firing pin. This releases the shoe from the firing pin and the shoe and firing spring may be removed. The sear and sear spring may be removed from their recess into the firing-pin hole with the fingers.

In order to facilitate assembling and disassembling a small hole has been drilled and tapped in the sear and firing-spring shoe, into which the end of the trigger-shaft detent which has been threaded to fit may be screwed when difficulty is experienced in assembling or disassembling these parts.

To Assemble and Mount the Breech Mechanism.—The firing mechanism having been assembled in the block place the hubs of the extractors in their respective recesses, insert the extractor plungers and plunger springs and place the plugs in the ends of the springs. Compress the springs and place the plugs home. Place the outer end of the operating arm in the slot in the block, insert the block in the recess from the bottom and push up until ¼ in. above the closed position when the hub of operating arm may be pushed into its recess in the breech of gun. Insert the operating shaft. Place the operating handle on end of operating shaft. Place the forks of the operating-shaft detent in the groove in the operating shaft and rotate until it locks in place. (Slack off on the nut which holds the closing-spring follower in place.) Assemble the closing spring and the piston. Assemble the closing-spring case in position on the dovetail and insert key, forcing home on the dovetail. Assemble spring, spring piston and chain in case. Connect chain with lug on operating handle. Screw up the piston-rod nut until spring is compressed prescribed amount. Place the trigger shaft in its hole and push the detent home. In inserting the trigger shaft it should be given a slight blow with the hand to center the firing arm, so that the trigger shaft may be properly seated.

This may be done either with the block mounted or dismounted. It is impossible, however, to mount or dismount the block with the trigger shaft in place. The firing mechanism is assembled as follows: Place the firing spring in the firing pin, place the shoe over the end of firing spring, engage the flat end of the trigger shaft in the slot in the shoe and turn so that the pin on the shoe is opposite the rear end of the slot in the firing pin. Push down on shoe until the pin on the shoe is opposite the shoulder in the slot in the firing pin. Turn the shoe counter-clockwise until the pin engages forward of the shoulder in the slot and locks the parts together. Insert the end of the firing arm through the slot in the firing pin. Place the sear spring in the sear and place the sear-end spring in place either by removing the short screw which closes the left end of the sear hole or by using a knife or a small pair of pliers and inserting from the firing-pin hole. Insert the assembled mechanism in the recess in the block and screw home the faceplate. This completes the assembling of the firing mechanism with the exception of the trigger shaft, which must be assembled when the block has been mounted in the breech recess.

There are four types of 75-mm. field gun, Model 1916, known respectively as Model 1916, Model 1916 MI, Model 1916 MII and Model 1916 MIII.[1]

Gun No. 1 is the only Model 1916 gun. It has a breech ring and jacket in one piece, and the jacket is locked to the tube by a locking hoop which is threaded to the jacket and bears against a shoulder on the tube.

Guns No. 2 to 82 inclusive, are Model 1916 MI. They have a breech ring and jacket in one piece. The tube is threaded into the jacket with a thread at its breech end. The locking hoop is not threaded, but holds in place a filling ring and locking ring, which locks the tube and jacket together by flanges fitting into grooves in each.

Note.—Guns Nos. 1 to 15 inclusive and No. 37 have a patch attached to the lower part of the breech and two dovetails, one in the rear face of the lower recoil lug and the other in the lower part of the operating recess. Guns No. 83 to 262 inclusive are Model 1916 MII. They have the breech ring threaded on the end of the jacket. The tube is held in the jacket in the same manner as in MI. The locking hoop, locking ring and filling ring described under the previous type are also retained.

Shop Training School for Women

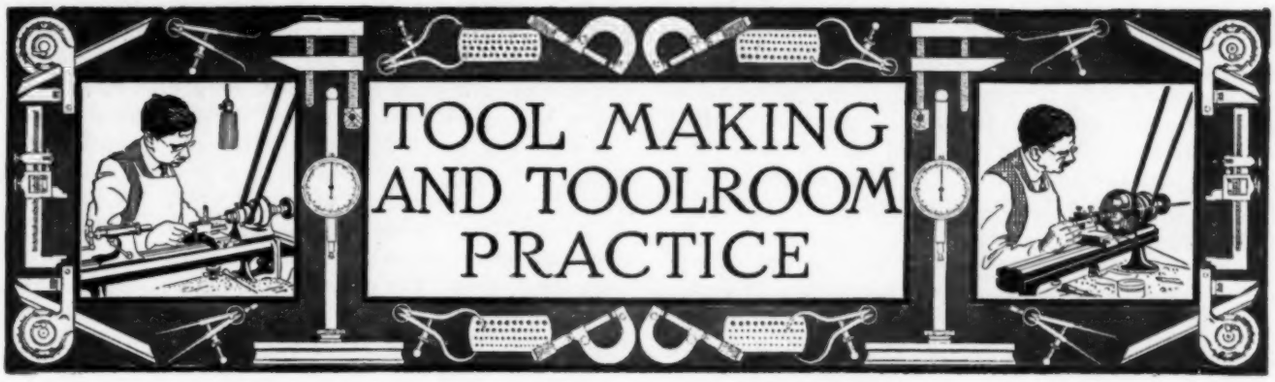
SPECIAL CORRESPONDENCE

The shortage of male labor in the shops and other industries has made necessary the employment of women and girls for work which before the war was considered as belonging to men.

Many shops and factories are now training and using large numbers of women and girls, and some have established regular training schools; but most of them are putting the women on special jobs which do not require any great amount of mechanical skill.

The Steinle Turret Machine Co., Madison, Wis., has up to the present never employed female labor, but realizing that women must be given men's places in their shops they have started at the bottom of the matter. They have set aside a special room for training women for shop work and have equipped it with the latest types of machines, which include a tool-grinding machine, a 20-in. drilling machine, a No. 3 hand-milling machine, a 16-in. engine lathe and a 36-in. open-side planing machine, besides work benches and other accessories. This room will be under the direct supervision of their most expert mechanic, and will accommodate six women at a time, each one being given about one week of instruction on each machine. During the training period the women will be paid a regular wage of about 25c. an hour, and as soon as they qualify for shop work they will be paid the same as male employees.

[1]Guns Nos. 263 and later are model 1916 MIII and differ from the Model 1916 MII type in that the locking hoop, locking ring and filling ring are eliminated and the jacket elongated to inclose that portion of the tube inclosed by the locking hoop in the Model 1916 MII type. The mechanism, operations and outside dimensions of the Model 1916, Model 1916 MII and Model 1916 MIII types of this gun are the same, therefore only the Model 1916 MIII, or latest type of gun, is described.



Elements of Gagemaking—V*

By C. A. MACREADY

The magnetic chuck for holding work during various machining operation is of comparatively recent development. While fairly common in toolrooms it is practically unused by the average machinist. This article shows its application to various types of gage work.

ELECTROMAGNETS simplify the attaching of work to fixtures that may be improvised out of cast iron or steel, and thus are of a temporary character to suit the job. There are of course many fixtures used for duplicate work which are of a permanent character. To insure durability these should be made of hardened steel. Unless there is excessive overhang, slippage of the work is the only thing that has to be considered when holding work by magnetism. Slippage is prevented by temporary stops placed on the face of the chuck. Magnetic poles, if properly connected, are strong enough to hold work to adapters while temporary working surfaces are ground. After these temporary working surfaces are machined the heavier cuts can be taken by using the face of the chuck or suitable adapting pieces that will allow full contact with these ground working surfaces. A large part of the stock is removed at this stage, leaving about 0.001 in. on each surface that has to be located properly for finishing. The poles in magnetic chucks are termed the north and south, and to differentiate between them we will mark the north pole *N*, and the south *S*. On the face of the chuck marked *A*, Fig. 70, the *N* poles of the chuck are represented by the metal inside of the insulation, and the *S* poles by the face of the chuck outside of this insulation.

There are several designs of the *N* and *S* poles made by different manufacturers, but it will be found if a trial is made with various *N* pole designs that the dotted lines on the face of the chuck in Fig. 70 inclose approximately the limit of the *S* pole surface that can be used for the contacts described in this article.

If the piece marked *B* is placed on the surface of the chuck so it will be over a part of the *N* and *S* poles it will be attracted to the face of the chuck without making contact with the outside pole *C*. If the back pole *C* is in contact with the piece *B*, the magnetic attraction will be increased, and the piece *B* will be attracted to the face of the chuck with practically the full force of the magnetism.

There are times when it is necessary to place adapting pieces on the face of the chuck so that the work may seat upon some particular place. It will be noticed when the work *D*, Fig. 70, is placed on the adapters *B* and *E* they will not hold the piece *D* very well; but if a contact is made with the back pole *C*, as illustrated by dotted lines, the work is held firmly enough to be ground. This is a point that must be remembered. Contact

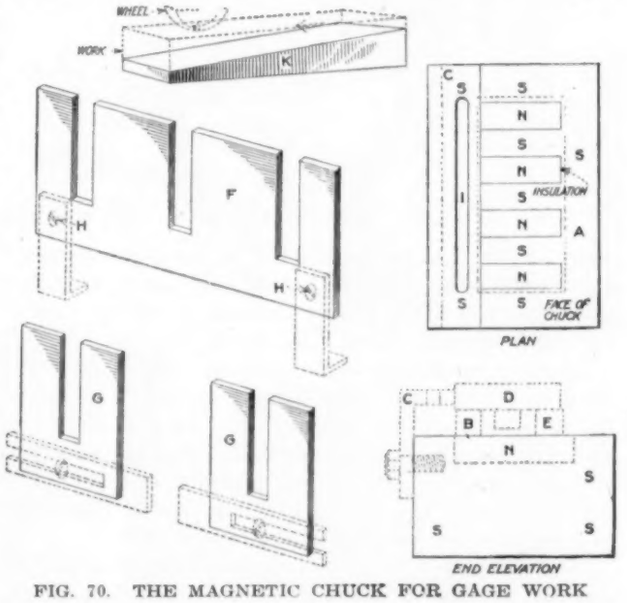


FIG. 70. THE MAGNETIC CHUCK FOR GAGE WORK

with the south (*S*) pole *C* (which includes almost all of the face of the chuck outside of the insulating metal that surrounds the *N*, or positive, poles) can be taken advantage of with an extension that can be attached to the back pole *C*, or by contact of some description with the face of the chuck outside of the *N* poles. In Fig. 70 the back pole *C* is shown slotted at *I*. This allows the pieces *F* and *G* or any suitable piece for a contact to be attached to *C* with a nut and screw and adjusted as required. The dotted lines on *F* represent pieces of

*Prepared for the author's forthcoming book on gagemaking.

flat-ground stock attached to *F* by screws *H*. There are occasions when a slot is required to be parallel with adjacent sides that have spots ground on them for work seats. These narrow extensions are placed to the best advantage and then trued up lengthwise by grinding. They are also used to locate narrow slots. It is evident that they can be bent at right angles, and the side of a slot can be used to align the work on the bent part.

There is another point that should be remembered. The work surface that has the greatest area in contact with the adapters will be the controlling or locating surface. The piece marked *K* in Fig. 70 is a taper wedge used as an adapter for certain classes of angles. It is placed close to, but not touching, the back pole *C*. The side is trued lengthwise with the aid of an indicator because the adjustable back pole *C* is generally higher than the thin end of the wedge. The rotation of the wheel should be toward the thick end of the work. There may be wheel effects that by distortion cause the work to loosen. If this happens and the work slips it will slip away from the wheel and not cause the work to wedge between the adapter and wheel.

This wedge adapter will cause some gagemakers to think of the side-swiveling chuck and the longitudinal type of chuck for gage work. While there are a good

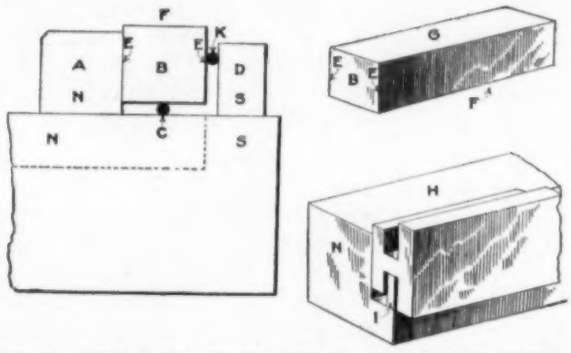


FIG. 71. SQUARING WORK IN THE MAGNETIC CHUCK

many angles that can be ground on these chucks there are a great many pieces of work that are so thin and small that the wheel will be liable to grind the face of the chuck when it runs off the work.

There is another decided objection. When replacing work on the chuck to take off perhaps 0.0002 or 0.0003 in., it is very difficult to return the work to the exact place from which it was removed, and with obtuse angles a slight change in replacement necessitates a change in the position of the wheel, which makes it impossible to accurately remove the 0.0002 or 0.0003 inch.

Both of these taper-grinding chucks are excellent for angular work with clearance between the face of the chuck and the wheel such as the master-angle blocks used as adapters in this article.

In Fig. 71 there is illustrated a combination that will produce a surface accurately at right angles to the sides of pieces that have already been ground parallel. The first example shows it as used at the front of the chuck. The piece *A* is one of a number of rectangular pieces, the sides and one end of which are at 90 deg. to one another. There should be several lengths and widths of the pieces *A*, as these are used in combination with each other. The end should not extend over the dotted lines in Fig. 70 on to the outside *S* pole. If it does a part of the magnetic force will be lost.

The sides and ends of the piece *B* in Fig. 71 are required to be parallel and square. The opposite surfaces *E* are ground parallel, using the face of the magnetic chuck. The piece *A* is placed in a position that will allow the work to extend over the *S* pole. A piece of drill rod *C* large enough in diameter to raise the work above the chuck is used to keep the work from contact with the *N* pole. The piece *D* need not be square or its sides parallel, but will work better if smooth on the bottom and sides, as the actual contact of metal to

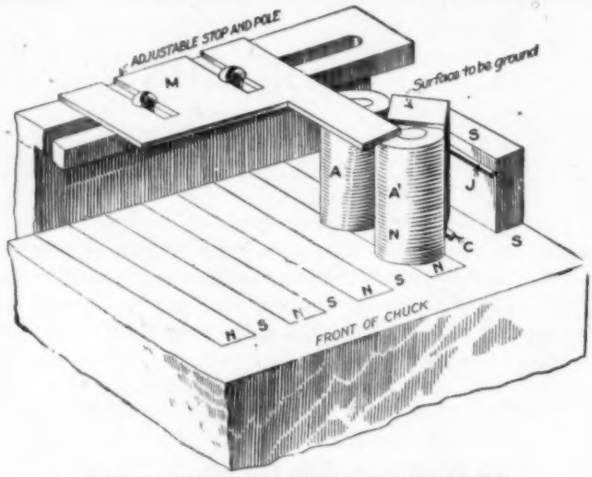


FIG. 72. SQUARING THE ENDS OF WORK

metal will make a conductor for the magnetic forces uninterrupted by an air space which is a poor conductor of magnetism.

The piece *D* should be high enough so that another piece of drill rod *K* can be used as a contact about central, as shown on piece *B*. If the piece *A* is square, as it is the controlling surface, the side *F* being ground will be square with the sides *E*.

The drill rods eliminate any "out of square" that might be in the surface *G* and the conductor piece *D*. They also transmit the control of the piece *B* to the contact surface on the piece *A*.

The reason that the piece *B* was placed so far back over the *N* pole was to allow room on the *S* pole for the piece *D*. On work thin enough to allow this room the piece *A* should be placed close to the *S* pole, but not on it. It will be safe practice to place a piece to "butt" against in order to keep the work from tipping or sliding. This combination is used at the right-hand end of the chuck if necessary, the piece *A* being placed on the *N* pole.

The face of the chuck is cleared and used to hold the work to finish the surface *G*, placing the side *F* in contact with the face of the chuck.

The adapter illustrated at *H*, Fig. 71, is used in place of the adapter *A* for holding some styles of gages. The finishing of surfaces with relation to a narrow slot is in many cases easier than making the slot with relation to the outside surfaces. The projection marked *I* is either attached with screws or is an integral part of the adapter.

The adapter required to square the ends will depend upon the length of the work. The combination illus-

trated in Fig. 72 is a combination that will handle the general run of short lengths. The cylinders illustrated at *A*, Fig. 72, are probably the handiest combinations of poles that can be used for this purpose. This combination will hold a round, square or any polygon. The cylinders are easily and accurately made, and with the adjustable back pole *M* will very accurately locate work that extends as much as 50 per cent. above the cylinders.

These cylinders are made of low-carbon steel, case-hardened and ground truly cylindrical; at the same setting the ends are ground square with the cylindrical body. Their accuracy can be checked by placing them

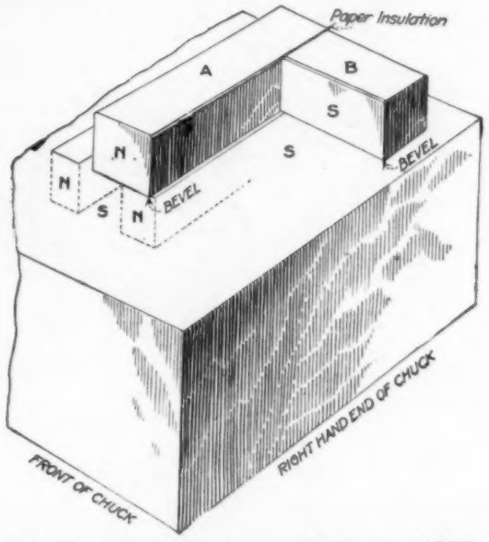


FIG. 73. INSULATING BY MEANS OF PAPER

on end, side by side, on a surface plate. The error if any will show double and can be corrected by lapping. The flat place on the cylinder *A'* is trued by placing it upon the face of the chuck and in contact with the back pole. With the flat surface approximately parallel with the face of the chuck and by using light cuts a sufficient amount is ground off to true the flat surface. The back-pole extension *M* is only used when the work extends to a dangerous height above the cylinders. When making contacts with the work, the work should not be adjusted to these extensions. The extension should make its own contact by swinging into place after the lower contact completes the circuit; then the screws that hold *M* can be tightened. The piece *C* can be anything that will raise the top of the work above the top of the cylinders and at the same time not interfere with the contact of the work with them. A drill rod *J* is used between the pole and the work.

The combination *A*, *B*, illustrated in Fig. 73, is made up of rectangular pieces similar to those shown at *A*, Fig. 71. These rectangular pieces should be beveled at the edges. This permits dust that is difficult to remove entirely from a sharp corner to be removed easily. There is one point that will have to be avoided in this combination. If the piece on the *S* pole is allowed to "make contact" with the one on the *N* pole the work will not be attracted to the poles as strongly as it will be if the poles are separated. A piece of paper is all that is needed to insure this separation and act as an insulator, allowing the work to complete the magnetic circuit.

A rectangular block is illustrated at *A*, Fig. 74. This will hold certain shapes so that their ends can be ground square with their sides. A cylinder, or any shape with sides parallel to the axis, can be held on the block *A*, but, with pieces so shaped that a sharp edge makes one of the seats on the block *A*, there is liable to be an error caused by the sharp edge not being paralleled with the axis. The adapter *B* has a tapped hole for a ⅜-in. screw. It is first surfaced-off in position on the chuck. The work holder *A* is then attached to *B* by a ⅜-in. screw. One end of the work is ground off to a finish. The block *A* is then turned over without disturbing the work and the other end is ground to finished length.

The adapter *B* is only used when the work is so long that it would strike the bed of the grinding machine when the work holder *A* is reversed. It was mentioned that "if the piece on the *S* pole extended over the *N* pole" the poles would lose a large amount of their magnetic attraction. The block *A* is one of the few cases that require the short-circuiting of the magnetic forces so

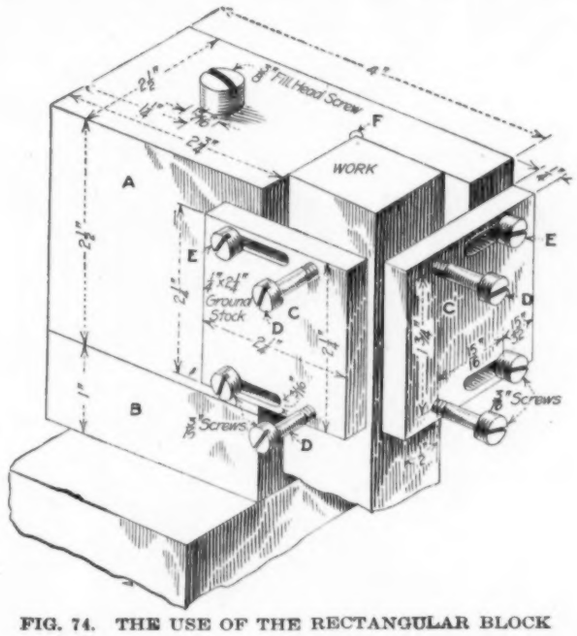


FIG. 74. THE USE OF THE RECTANGULAR BLOCK

much that an outside clamp to hold the work is made necessary.

Two pieces *C*, *C'* are attached with screws *E* to the block *A*. The slots in these pieces will allow the work-holding screws *D* to be so placed that they have a pressure a little beyond the center of the work. This causes round work to be forced toward the corner. If the heads of the screws are knurled a screwdriver will not be needed; if a screwdriver is used do not apply force enough to distort the block *A* at the point *F*.

When grinding angles as illustrated in Fig. 75 it will be more convenient to use the front pole of the chuck to hold adapters and work, as these surfaces are easily inspected for dust and contact.

The contacts explained in Figs. 70 and 72 are applicable to almost everything that can be held by magnetism. The plain-angle gage *B* illustrated in Fig. 75 will be taken as an example. It is required to grind its angular sides. The originating of the master angle *A* will be taken up later. This master angle *A* should be of hardened steel with the temper drawn down to a

dark-straw color. Its height and length are determined by the size of the work. The width of the base should cover three *N* poles. Two No. 12 screws in a line will be sufficient to hold the opposite angle *C*. There should be several rows of holes to accommodate different positions of *C*.

The addition of the piece *C* renders it possible to make the male templet usually required for a standard to test the female gages, and also to use it as a V-block when grinding the sides of gages that contain holes having positive relation to sides or flat surfaces. As when new these male standards have sharp edges, the base of the angle can be measured close enough to form one of the elements necessary when finding the height required above the sharp edge to produce a certain width of the surface *D* of the gage. To adjust the piece *C* a long plug gage *E* is placed in the angle. The No. 12 screws are tightened just enough to allow the piece *C* to be adjusted so as to bring the plug *E* shown in dotted lines parallel with the bottom of the master angle *A*. Tinfoil between pieces *A* and *C* insulates the *N* and *S* poles. This increases their magnetic pull, as with the

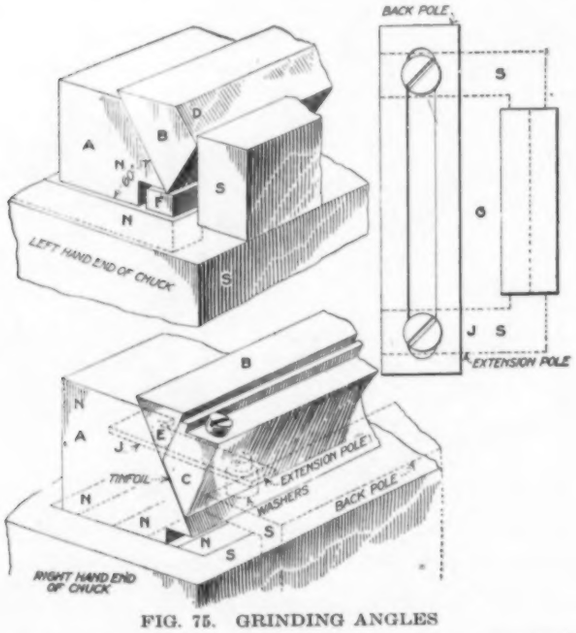


FIG. 75. GRINDING ANGLES

paper used in Fig. 73, but permits the use of gasoline to clean the surfaces.

The piece *F*, Fig. 75, should be used when possible. It is a hardened parallel strip that acts as a bed for the work. Small angular gages have often to bed directly upon the face of the chuck. As the edges are often sharp and have an abrasive action they are liable to wear a slot in the face of the chuck unless care is taken to avoid it. The edge of the master angle that beds on the face of the chuck for small work should be slightly relieved for dust room.

To increase the magnetic pull the extension poles *J* shown in dotted lines are used in combination with the back pole. A part of a plain view is illustrated at *G*. The dotted lines show the extension poles *J* raised with washers to the desired height.

In Fig. 76 there is illustrated a simple solution for the production of the piece *C* that was used in conjunction with the piece *A* in Fig. 75. The sketch *G*, Fig. 76, with the desired angles, is drawn on a piece of paper. The side *D* is determined by the size of the master angle *A*. This master angle is the one that is to be used with the piece *C* in Fig. 75. When the lines on the sketch are placed in the position that the piece *C* will occupy on the piece *A* in Fig. 75 it will show that the sides *D* and *A*, Fig. 76, if produced from the base *A*, are the only ones that require accuracy. This graphical application will clear away the confusion that generally accompanies angular "layouts."

The cylindrical parallel *F* will position against any angle or taper that the side *E* may have. The side *E* is planed approximately in line with the side *D* after

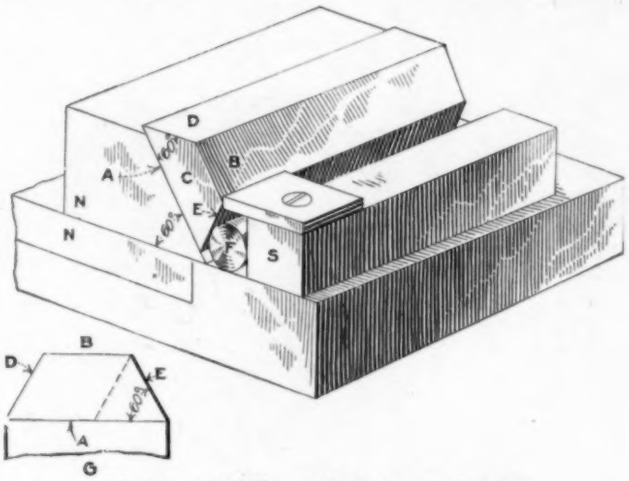


FIG. 76. MAKING ANGULAR ADAPTERS

the side *D* has been machined. Or it can be machined approximately to the dimensions wanted; the holes drilled; then, after hardening, the sides finished. The side that is concave from the hardening distortions should be used on the cylindrical parallel *F* when grinding the surface *D;* this will keep the work from rocking. The extension poles are used on this piece the same as in Fig. 75 at *G*.

The locating of angular surfaces with relation to three holes is illustrated in Fig. 77. One may see in this figure the same master angle and polepiece *S* as used in Fig. 75, also the same contacts to hold the gage *B*, using the under side of the spheres only for contacts.

It will be noticed that the end view of this gage at *F* shows the holes an equal distance from the sides. With the ball buttons *C*, Fig. 77, which are used on this class of work, the axes of the holes can be placed any desired distance from the angular sides, the center of the ball being coincident with the apex of the angle. The end holes having been located to their center-to-center distances, as described in connection with Fig. 59, the center hole introduces an additional problem; but the locating of this center hole and the making of the ball button will be taken up later with the fabrication of another style of gage.

The surfaces *D* and *E* when ground parallel, the holes when properly located, and the center of the ball button at the apex of the angle as illustrated at *G*, Fig. 77, provide a series of locating points from which a surface can be originated, and this surface can be used to measure from provided the ball is a true sphere and its diameter is known. Measurements are of course made from the outside surface of the ball.

If one looks at the layout of this example of seating work on the chuck illustrated in Fig. 77 it will be noticed that the poles can be used in the same manner as described in previous examples.

There are two elements in this way of holding this class of work on inclined surfaces that are liable to cause error, i.e., the placing of the ball button in contact with the *S* pole block, and using it as the fulcrum of a lever. This will cause the lower edge *I* of surface *E* to be in less firm contact with the *N* pole block *A* than its top seating surface at *J*. Also the cylindrical piece *H* is not a very firm seat for the work, but can be more

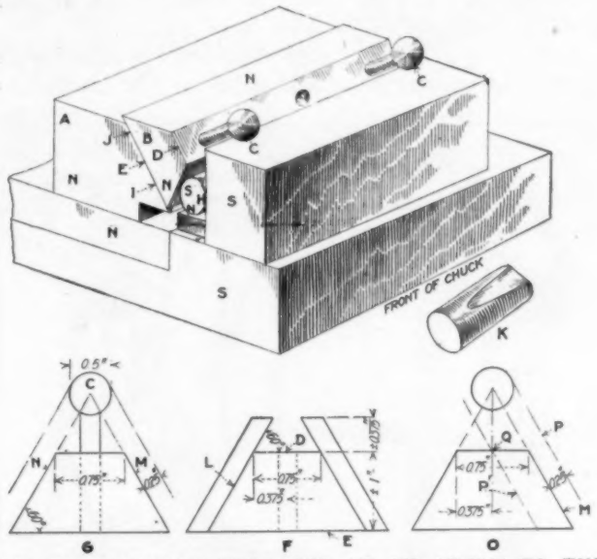


FIG. 77. LOCATING SURFACES AT AN ANGLE TO THE AXES AND HOLES

firmly attached to the *N* pole if a small wedge-shaped piece is placed between the *S* pole block at each end. This is not shown in place in the illustration. This wedge *K* is simply a short piece of drill rod filed tapering. The displacement of the piece *H* will most likely be caused by a dull wheel or an excessively heavy cut. As the surface *L* illustrated in the end view *F* is used for a seat to rest in the V-angle made by *A* and *C* in Fig. 75, the parallelism of surface *L*, Fig. 77, to the buttons will be proved when the surface *L* is placed in this V and the heights of the balls measured from the base placed on a surface plate.

The illustration at *O*, Fig. 77, gives a layout of the problem used to figure the angles to find the width of the base, which may be any width other than 0.75 in., the size shown in this example.

If one will forget that angles are being used instead of parallel lines and remember that a set of simple, easily understood tables convert these angular lines into parallel lines as illustrated at *P* and *P'*, making a measurement with a height gage from the ball *C* or line *P* to the surface *M* of the gage is a simple thing to do providing the surface *M* is placed in the V of the master angle which will bring it parallel with the surface plate. It will be noticed that the line *P'* parallel to the surface *M* of the gage passes at *Q* through the center of the 0.75 in. that is required for the base of the gage. This point is the center of the hole, and a perpendicular erected from it passes through the center of the ball and also the apex of the angle. As the height of this center or apex can be accurately located and the height figured from a proper table, using one-half of the base wanted—in this case 0.375 in.—the surface *M* will be below the ball *C* by an amount equal to one-half its diameter. If the ball is 0.5 in. diameter the surface *M* will be 0.25 in. below *P*. The solution of this problem will be used in another place when finding an unknown base and will be explained at that time.

When truing surfaces parallel to the axis of a hole the location and diameter of the hole determine the way the work shall be held. In Figs. 78 and 79 are illustrated three conditions that require different means of holding the work on the chuck. The piece *A* with the plug *B* on the parallels *C* and *D*, Fig. 78, has the hole with the plug *B* in it at one end. When there is a short overhang of the work, as illustrated at the *S* pole, the piece *A* can rest on a piece like *F* and in contact with *E*. The piece *F* has a screw to adjust the surface of *A* approximately parallel to the face of the chuck. The wheel revolving in the direction of the arrow, there will be no difficulty in grinding the top surface of the piece *A* parallel to the axis of the

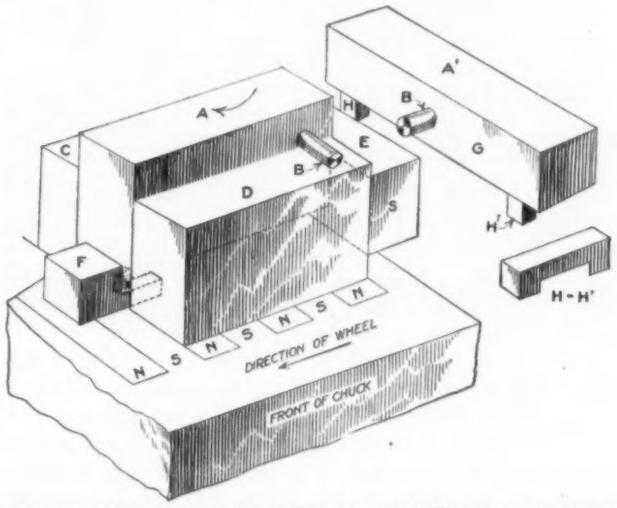


FIG. 78. LOCATING SURFACES PARALLEL TO THE AXES OF HOLES

hole. Light cuts should be used if the plug *B* is small in diameter.

With the hole in the center of the pieces as at *A'*, if the plug *B* in *A'* is placed on parallels and the ends supported by two pieces like *F* in Fig. 78, there is liable to be an error induced by one of the pieces *F* raising the work off parallels and causing it to rock sideways, change its position and become "crowning." To make a firm seat two temporary pieces *H*, *H'* are soldered to the bottom of the piece *A'*. They are made of soft steel and relieved at their centers as illustrated to save time when they are filed to bring the plug *B* parallel with the surface plate. After being soldered on the piece *A* they are ground parallel to the desired surface this being the quickest way to correct this error; they are then filed on the surfaces where necessary to bring the plug *B* parallel with the surface plate. These temporary seats are used on the chuck to hold the work while the opposite surface is being ground and are then removed.

In Fig. 79 we have a piece *A* that often causes trouble, as the sides *D*, *D'* of the piece *A*—which is the

wing of a gage—must be at right angles to the axis of the hole. Often the hole is so small that it is hard to grind. It is evident that the broad surfaces can be finished as described in Fig. 78. It is also evident that the one end of all these pieces can be trued if the plug is placed on parallels that are high enough to allow the long end of the work to clear the face of the chuck, and if one of the finished surfaces is placed against an angle iron on the *N* poles—the parallels being on

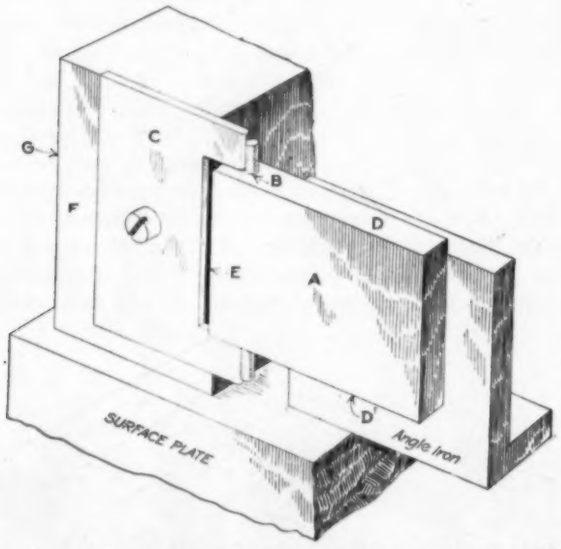


FIG. 79. LOCATING SURFACES PARALLEL TO THE AXES OF HOLES

these same *N* poles—the end will be square with the angle iron and parallel with the axis of the hole.

Very good success can be obtained if after squaring the end *E* the piece *A* in Fig. 79 is placed in the angle of the pieces described in Fig. 73. As the pieces *A*, *A'*, Fig. 78, do not have end surface enough to act as the controlling surface when grinding the sides we will use the square illustrated in Fig. 79 at *C* to adjust the work *A*, which is attached to an angle iron with clamps not shown, to bring the plug *B* square with *C*. The illustration shows the application of this method.

If the block *F* is made accurately 90 deg. to all sides there will be no difficulty in grinding the edge (used to square the plug *B*) parallel with the surface *G*, using the surface *G* to bed upon. When making the block *F*, if there are several No. 12 tapped holes in the sides for holding screws, it will make a very handy block for most anything that can be attached with screws for grinding.

There are certain errors that are sure to enter when a grinding wheel passes over a surface and produces a spark. When carbon steel is used for gages this spark is generally at white heat. This will cause the gage to distort. This distortion will be corrected by lapping, but lapping, unless very little is removed, will cause further distortion. This fact will call for the greatest amount of stock to be removed when roughing the gages to finish-grinding size and will leave the least amount to be ground off when the finishing cuts are made. Each surface should be inspected when ground or lapped to the desired finish, as the errors if not corrected will accumulate very rapidly.

Machine for Surface-Grinding Anvils

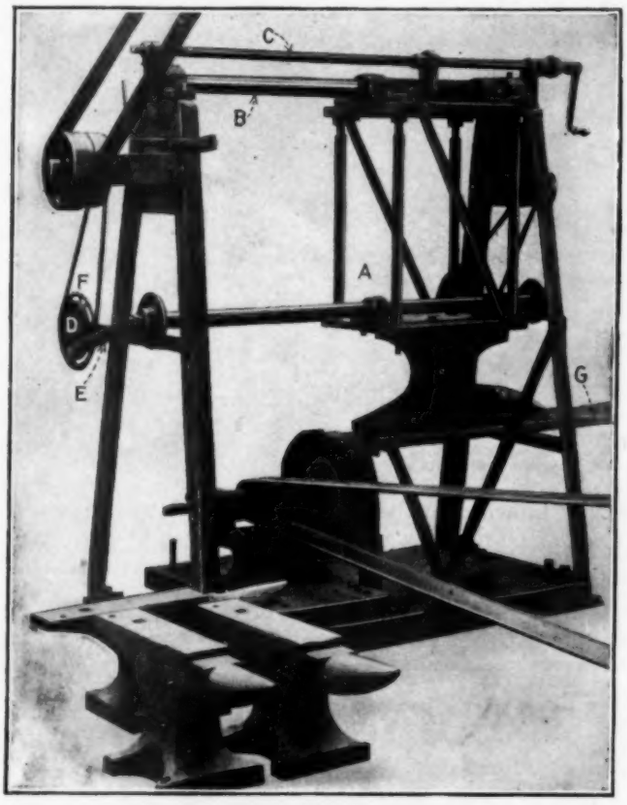
BY FRED D. HOOD

Head of Department of Mechanic Arts, Los Angeles Polytechnic High School

The illustration shows a machine for grinding the surface of anvils; it was built by the pupils of the Los Angeles Polytechnic High School entirely from materials available in the school shop and without other expense than the regular cost of class work.

The price of new anvils in this part of the country makes the value of the machine apparent. Five years ago a 130-lb. anvil could be obtained for about $12; today the price is $30. With the exception of chipped edges the reground anvils are as good as new.

Anvil faces are ground straight from end to end with about $\frac{1}{16}$-in. crown from front to back. The machine is



ANVIL-GRINDING MACHINE

constructed to accomplish this crowning by means of an oscillating or swinging member carrying at its lower end a platform to which is fastened, face downward, the anvil to be ground.

The oscillating member *A* carrying the anvil is moved along to the rod *B* by means of the feed screw *C*, thus passing the work over the wheel. While being moved forward in this manner the arm is swung from side to side by the crank disks *D* and connecting rods *E*, one of which is attached to either end of the arm and which are driven by means of the chain and sprocket at *F*.

Adjustment for varying height of anvils to be ground is effected by means of nuts on the upper ends of the four supporting rods which form a portion of the swinging member. A platform for convenience in mounting the work is shown at *G*. The time for grinding an anvil is about two hours. A few samples of the product of the machine are shown in the foreground.

Special Track Work for Street Railways

By J. V. HUNTER
Western Editor *American Machinist.*

One of the mechanical details of urban life that is perhaps the most seen and least observed is the track with its maze of switches, frogs and crossovers upon which run the street cars that more than anything else make the modern city possible. The average city dweller looks upon these tracks, if at all, to criticise or perhaps anathematize without giving a thought to the engineering problems involved in their construction.

THE ordinary layman crossing a street corner where two lines of railway tracks intersect does not realize, even when he gives thought to it, the time, labor and expense required to make and maintain the switches, mates, frogs and crosses over which he gingerly steps.

It may be thought that steel or iron wheels running on steel rails cause little wear; but the cumulative effect of the incessant pounding of hundreds of heavily burdened wheels passing over the same point every hour means the deterioration and ultimate destruction of the hardest of materials used in the construction of special track work. It is the effect of this pounding that has

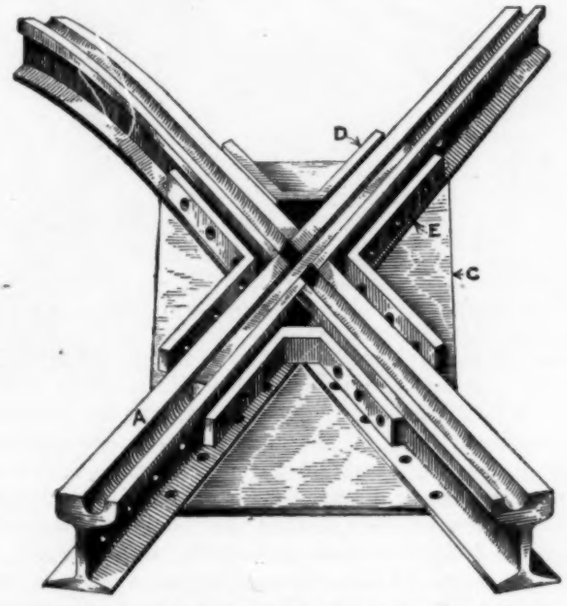


FIG. 1. STANDARD FORM OF CROSSOVER

brought about the installation of such special work in which each piece is a single rigid steel casting with renewable center wearing plates.

To resist wear the carbon in rails is kept at as high a point as is practicable. Various steel alloys are used for different classes of service, among the more common being vanadium and nickel steels. The most frequently used alloy, however, is manganese steel, the same material that is used for rock crushers, clam-shell bucket jaws, and similar parts that are subjected to severe usage. This material contains from 12.5 to 14.5 per cent. of manganese, and owing to the high cost of that element and the difficulty experienced in working the steel in the foundry and machine shop its use for track work is practically confined to the renewable center plates that bear the brunt of the wear from the car wheels.

For some years the Twin City Lines have been developing methods for building special work, three of which are employed for different classes of work, depending upon the service.

These three classes are: Built-up work made of rails suitably joined by splices and plates to hold them firmly in their relative positions; cast-steel special work without renewable centers, and cast-steel bodies with

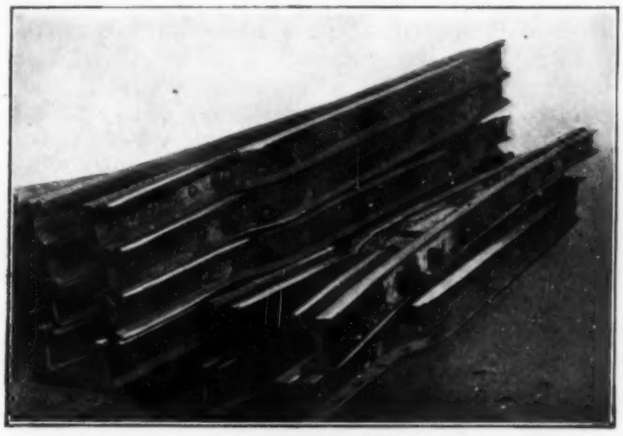


FIG. 2. PARTS OF FROGS

pockets for renewable center plates of manganese steel at the points of intersection where the greater part of the wear occurs.

The built-up special work is the simplest to produce, can be prepared in less time for emergencies and costs the least of the three. Its disadvantage, however, is that being made of a number of parts spliced and bolted together it is more severely racked by car travel and therefore has a much shorter life than either of the other styles. It is frequently made for emergency renewal or for work in outlying districts where traffic is so light that the expense of better sections is not warranted.

In Fig. 1 is shown the detail parts used in the construction of the regular built-up types of track crosses. These crosses, of course, vary greatly in the angles of intersection, depending on the particular curve where they are to be placed. These curves and angles are laid out full size on a smooth wooden floor, and from this layout full-size templets are made. The templets follow the gage line of the rail and give the lengths of the respective arms; this information is all the machine shop requires.

The mode of procedure can be seen from the diagrammatic view, Fig. 1, which shows the splices just outside of the crossed rails before they are ground to fit and bolted together. It will be observed that one rail *A* is continuous through the whole length while the curved

rail has been sawed apart at the middle of its length and fitted snugly against the sides of the other rail. These curved-rail sections are made from straight pieces and are bent by a hydraulic rail bender to the requisite form.

The base of these crosses is made of ⅝-in. steel plate, as shown at *C*. The rail sections are carefully laid out on this plate, marked in position and drilled and riveted securely to the plate through the base of the rail to prevent shifting. An outline is then made of the angles of the splices required, *D* and *E*. These are formed in the forge shop and sent to the rail shop, where they are ground to fit snugly into the sides of the rail sections. Holes are drilled through the corresponding arms and all parts bolted snugly together. Drilling the outside ends of the arms to fit standard rail splices completes the cross ready for use.

Switches and mates are made up in a similar manner. A general idea of the work on a standard built-up switch may be obtained from Fig. 2, which shows a number of these switches piled up on the floor of the rail shop. They are composed of two lengths of rail extending the full length of the switch, except that at certain points a portion of the running rail or of the guard rail has been cut away. This cutting is done on a vertical shaping machine. The rail lengths are then

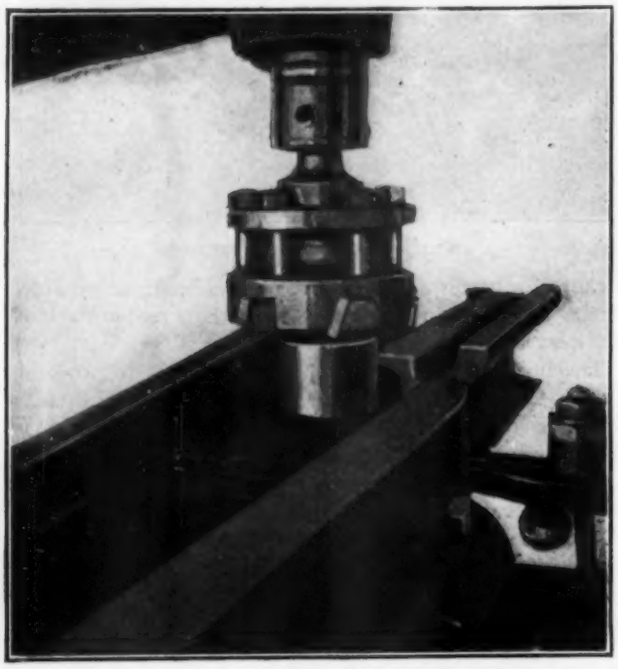


FIG. 3. MILLING POCKET FOR SWITCH TONGUE

sent to the forge shop, where they are formed up in the bulldozer by means of suitable dies.

The proper spacing is secured by means of filler blocks of cast iron and it requires nine of these blocks to complete a switch. In addition to the filler blocks there is one outside block made of cast steel. These filler blocks must conform to the shape of the rail sections.

In building up switches the hole for the switch-tongue pin is drilled from a templet. With the hole as a guide the milling tool, Fig. 3, cuts out the semicircular shape in the top face of the switch to fit the back end of the switch tongue.

The manufacture of cast-steel special work is very different from that of built-up work. The first questions to be solved were in connection with the design of these parts, and to some extent the work was guided by the design of similar pieces purchased from outside builders. The early design of these parts, which did not provide for manganese center plates, is shown at *A*, Fig. 4, which is a section through the center portion of

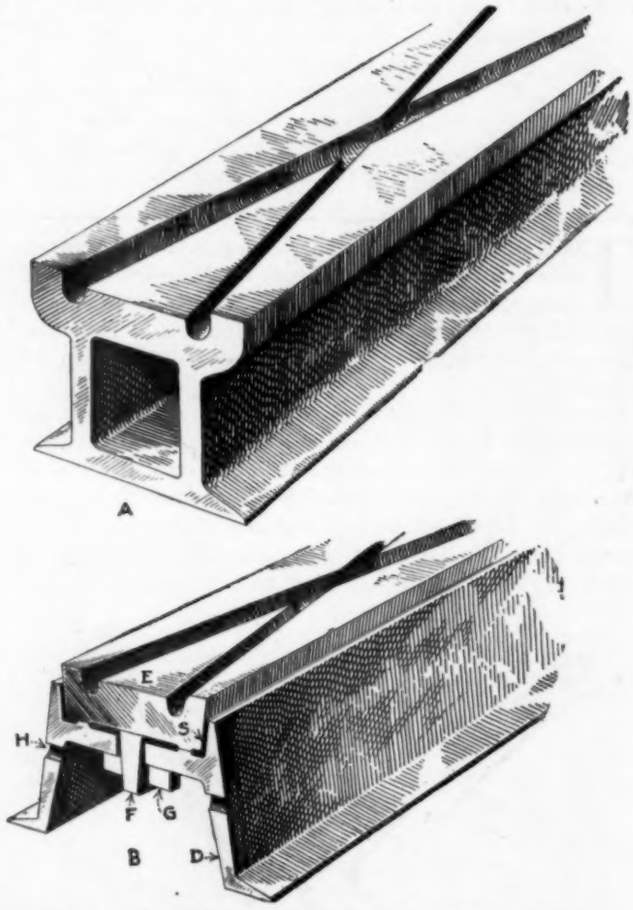


FIG. 4. SECTIONS THROUGH CENTER OF CROSSES

a cross or frog. With this design it was found difficult to obtain perfect castings or efficiency in molding, as in order to mold the form it was necessary to use a three-part flask and check off the middle portion, thus necessitating extra labor and difficulty in drying the drag and cleaning out loose sand after the cores were set. Extra work was also entailed making the requisite cores and occasional difficulties were experienced in venting.

The new type of pattern construction, known as the box type, was adopted before the manufacturing of manganese center crosses was started. A pattern for this type is shown at *A*, Fig. 5, in which a view of three types of crosses are shown. An idea of the box section may also be obtained.

Later, when manganese center plates were adopted, the first form of center plate was that indicated at *B*, Fig. 5. The pattern for the center plate stands at the base of the main body pattern. The center plate was held in position by a dovetailed lug on the side of the center plate and on the inside of the socket made to contain it in the main body. In order to obtain this dovetail it was necessary to core the sides of the cen-

ter plate and also the socket, as may be judged from the core print shown in the center of the main body pattern.

Shortly after starting to build this type it was found that if a different center plate was designed for each cross a large amount of time would be consumed in the pattern shop. Consequently these parts were standardized in three sizes and all crosses built later used one or the other of the standard sizes of cores and center plates. A pattern was always required for each center plate on account of the differences in the rail grooves.

Following this standardization it was found that the cores used for the rail sections on the ends of the arms

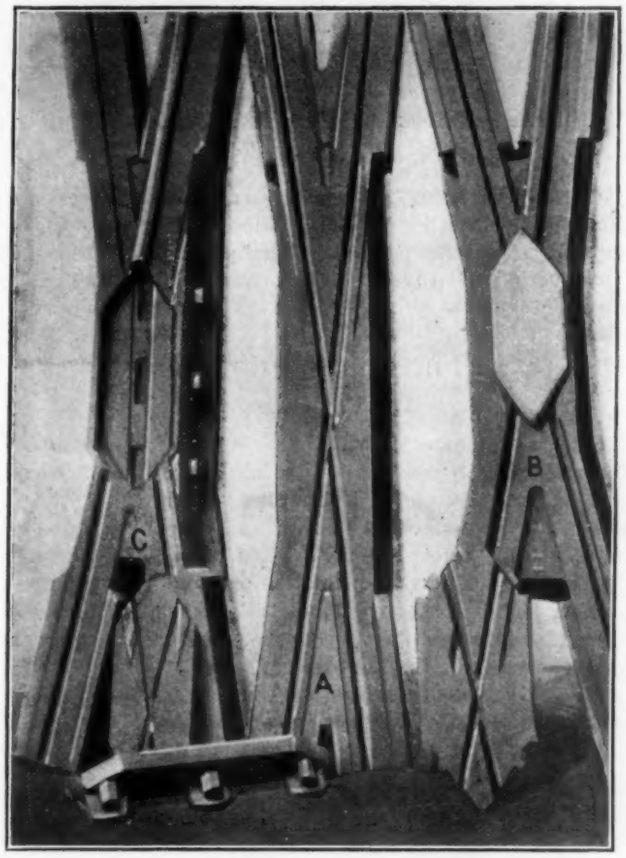


FIG. 5. STANDARD CROSSOVER PATTERNS

could also be standardized. This was immediately done on all new construction, and since that time no core boxes have been built for these arm ends.

Standard sizes of prints are put on each arm, and these are numbered to correspond with the core box to give the required form of rail sections. In connection with the work of standardization it was found that certain sections would always be the same size and that they could be run in the regular molding machine; thus by running large quantities at a time it was possible to have a stock of the different sections always on hand and expense of production lowered.

The latest type of manganese-center cross is indicated at *C*, Fig. 5, with two of the center-plate patterns lying at its base showing their general style. A section through the center of this cross is indicated in Fig. 4 at *B*.

In this section *D* is the main body casting, *E* the manganese center-plate. These plates have a loop *F* extending through an opening in the body. After it is fitted to place, the wedge *G* is driven through the loop to draw the center plate down as firmly as possible. Openings *H* are provided through the main body casting for the insertion of this wedge.

In order to reduce the amount of finish required on the base of the center plate a rib is extended around the bottom, meeting a corresponding rib in the center socket, and by grinding these two ribs the finishing of the whole surface is avoided.

After setting the center plates in place molten zinc is poured into the joint to fill all interstices and make the job firm and solid.

Some of this special work is quite large, an individual casting sometimes weighing as much as 2000 lb. An idea of the size of some of these pieces may be obtained from Fig. 6. In this piece are three intersections, each provided with a manganese center plate, the recesses of these showing plainly in the center of the pattern.

An attempt is made to keep the pattern section uniform throughout, as to have them otherwise would cause shrinkage strains resulting in cracks along the edges of the casting. Successful pattern designing and foundry practice methods is indicated by the fact that these cracks have been practically eliminated.

The patterns are always molded with the face down in order to assure the best possible steel at this point. Should small particles of slag run into the mold when pouring the steel the slag would collect on the surface farthest from the wearing face of the casting, and therefore do no harm.

The interior of the mold is whitened by the use of a silica wash for insuring clean castings. As the molds are finished and washed, and before closing, they are

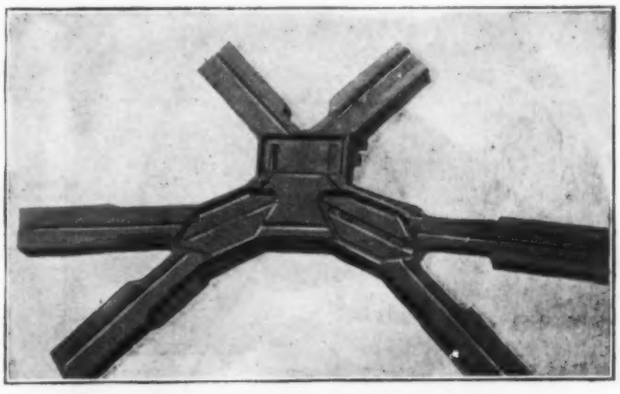


FIG. 6. LARGE THREE-WAY CROSSOVER

run into an oven and baked for about 12 hours. The baking prevents the porosity which sometimes occurs in steel castings due to the generation of steam.

After shaking the castings from the sand they are loaded without cleaning on a steel truck, as shown in Fig. 7, and taken to an annealing oven, where for 12 hours they are subjected to a heat of approximately 1550 deg. F. After annealing they are sandblasted, chipped and, when necessary, straightened.

The straightening is done hot. The pieces are heated on a small furnace to a low red heat and taken to a heavy special surface plate, where by means of powerful screw clamps sufficient pressure is applied to bring them to match the templet.

The treatment of the manganese-steel center plates and switch tongues is somewhat different from that used in treating the other castings. These come from the mold remarkably clean—a feature of this steel—and seldom require sandblasting. They are glass hard and cannot be chipped, but the steel is remarkably brittle in this condition, and the fins, risers and gates are easily broken off by a few taps with a light sledge. A special heat-treating furnace is used for handling these steel castings, in which furnace they are heated to a temperature of about 1900 deg. F. When thoroughly heated they are withdrawn and plunged in a quenching tank. Sometimes these castings require straightening, but they cannot be heated as were the others, and may be only warmed up slightly until hand warm. The worker tests this heat with his hand, and when they are ready he places them on the faceplate and applies sufficient pressure to straighten out any slight curvatures.

The final machining operations on the body castings are performed in the rail shop, where the same templets used by the patternmaker are fitted to them to determine the exact point at which the arms should be sawed off; these ends are removed by a circular cold saw. The patterns have been built with the arm about 4 in. longer than the finished piece to permit necessary fitting of the templet; also to allow for the removal of possibly faulty steel on the ends of the castings. They now go to the planing machines for finishing.

The manganese-steel castings cannot be finished by machine operations and it is necessary to grind them to a finish where required. A swinging grinder is used for this purpose. After fitting the manganese plates they are wedged into place in the casting and the crev-

FIG. 7. ANNEALING THE CASTINGS

ices filled with molten zinc as previously mentioned. Fig. 8 shows two crosses, the edges where the manganese centers join the other steel parts being shown.

During the winter it is customary for the shops to build standard parts which will be required for the next summer's construction work. Such pieces will include right- and left-hand switches and mates and such crosses and frogs as can be planned for standard designs of crossovers.

When starting to build any track construction the required parts, if standard, are drawn from stock; special pieces are made and delivered by the shops. These are all laid out in a large, level, cinder-covered lay-out yard in the position in which they will later be permanently

FIG. 8. SPECIAL TRACK WORK IN THE YARD

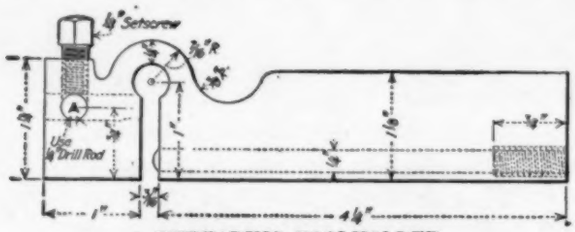
placed in the street, and to this lay-out the necessary pieces of connecting rails are fitted and bent to form, so that when the parts are finally taken out on the construction job there will be little time lost in fitting them into place.

A Threading Toolholder

BY V. J. JACOB

The sketch here shown is that of a form of thread toolholder that works very nicely upon small work and it has a number of excellent features that are not at once apparent. The idea was borrowed (as was also the original tool) by me from a fellow toolmaker, and as its good points did not impress me until I had put the tool to use, I desire to enumerate them for the benefit of your readers who may wish to make one for themselves as I did.

The sketch with notations is entirely self-explanatory so far as the construction is concerned. The tool bit



A THREADING TOOLHOLDER

is a piece of ¼-in. drill rod, and by changing the flat spot on which the setscrew bears the tool can be set to the correct angle for any thread. The length of the tool bit is such (approximately 1¼ in.) that after being ground sharp to 60 deg. the amount of flat to put on the end may be determined by measuring over all with a micrometer.

The holder may be used for either external or internal threads by making a suitable internal-threading tool to fit the cross hole at *A*, and it may be either a spring holder or solid, according to whether the screw at the back end is set up or not.

In making this tool I made the holder of cold-rolled steel, and experience shows that this material leaves nothing to be desired.

Series for the PLANNING DEPARTMENT

Preliminary Planning of Shop Operations—II

By ALBERT A. DOWD

Preliminary to starting the manufacture of a new part or article it is advisable to make a complete layout or schedule of operations through which the piece is to pass, so as to provide a definite order of procedure to be followed by the man in the shop

IN A previous article the matter of data in the planning department was considered, and we may assume that the department is thoroughly equipped in this respect. The engineer in charge of the planning department must be in close touch with the department of design and should be consulted when anything comes up which is likely to affect the machining operations. Frequently a consultation between the chief of the designing department or chief draftsman and the engineer in charge of the planning department results in slight modifications in design to facilitate machining of some piece or another, and in this way considerable expense is saved. Unfortunately not all designers are practical mechanics so that occasionally the proposed design leads the tool engineer into difficulty with regard to the machining of the part. It is natural that the designer should wish to make the mechanism as nearly perfect as he knows how, and in doing this he does not always consider the machining end, so it will be found that coöperation between the tool-engineering and the designing departments will be profitable.

Tolerances and Limits

When interchangeable work is to be manufactured it is necessary that all parts to be machined be properly marked to show the tolerance permissible. It is apparent then that before the tool engineer can go ahead with his work the blueprints of the parts must show the tolerances in order that the required accuracy shall be attained. The variation allowable in two parts which are to fit together is of the greatest importance, as the efficiency of the finished product is largely dependent on the care used in establishing the tolerances. Custom differs in factories, but in general the blueprints are marked with ± limits on important fits. Ordinarily a bearing fit is marked with the permissible variation, while a drilled hole is not given any tolerance whatever, it being assumed that the drill will produce a reasonably good hole. Length and depth of shoulders are frequently not marked on blueprints, or else there is an understanding that a tolerance of $\frac{1}{64}$ in. is permissible unless otherwise specified. It is my belief that shoulder distances and over-all lengths should be given tolerances or that a notation be made on the drawings to the effect that over-all lengths are to be made within a tolerance of $\frac{1}{64}$ in. unless otherwise marked. At any rate the matter should be taken care of in a definite manner so as to eliminate the chance of error.

Assuming that the tolerances have been specified the tool engineer, who should understand the nature and functions of the parts he is to machine, can now go ahead and plan the operations.

Fig. 11 shows a gearshaft fork used in the transmission case of an automobile. This is a drop-forging of alloy steel and is finished almost all over, although great accuracy is not required in all operations. The tool engineer looks over the drawings to determine what operations will be necessary, after which he looks into their sequence, the methods of locating the piece to produce accurate results and other points in connection with the machining. He then determines what special tools and fixtures are required and also considers the matter of gaging to keep the work within the required limits and the type of machine tool best suited to the various operations.

Having made a tentative list of operations the engineer now makes a few free-hand sketches to illustrate the methods he proposes to use. A sheet of such

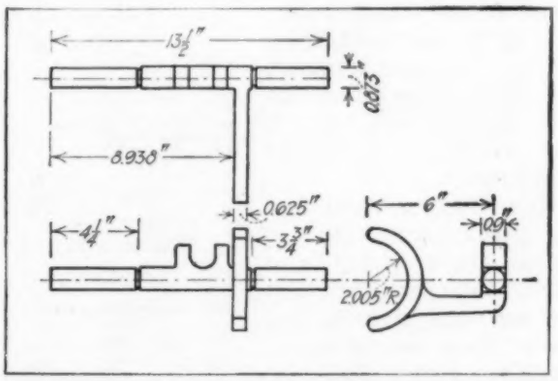


FIG. 11. EXAMPLE OF PIECE TO BE OPERATED UPON

sketches showing the method of handling the piece shown in Fig. 11 is illustrated in Fig. 12. They are frequently crude affairs intended only to show roughly the methods of locating and holding the work, and may be kept numerically in a loose-leaf book according to the number of the piece. In this way when the work on tools and fixtures for the specified piece is in progress the tool designer can go ahead without asking many questions. There is, however, always the possibility of changes in methods of handling. Things will show up all right on a free-hand sketch which when drawn to scale may not look as well. There may be interferences

of various kinds with parts of the machine tool which may necessitate altering the method, and these points should be taken up with the tool engineer.

It is apparent that the sketch must be taken with "a grain of salt," not being intended as anything more than a guide for the tool designer. The locating points should be specified and the general method of holding, together with a notation of the type of machine on which the fixture is to be used. The tool engineer in the limited time at his disposal cannot always go into all details of setting up the work in the fixture, but he can determine the locating points and note the particular machine that he wishes to use. It is left for the tool designer to do the rest, but it is understood that he must conform as far as possible to the tool engineer's layout.

Generally speaking it will not be found advisable to lay out a complete operation sheet until the design of tools has been thoroughly considered. It may be found that the preliminary sequence of operations may be improved by so transposing one or more of the operations as to obtain better locating points and simpler fixtures. Generally, however, the tool engineer knows just what fixtures can be best used, so little change should be necessary.

After being assured that the preliminary layout is correct, the next step is to lay out the operation sheets for the work in a finished state. To a certain extent conditions govern the form of the operation sheets in many factories, but speaking broadly the form shown in Fig. 13 will be found to be serviceable, as it gives every important detail in regard to machining the piece for which it is intended, as well as all drawing numbers and all requisite tool equipment. A sheet of this kind can be made up on thin paper, blueprinted and bound in a loose-leaf book for ready reference. A record of this kind cannot be overestimated, and although its cost may be considerable it results eventually in a saving in manufacture and in a completeness of the record. Referring to the illustration it will be seen at the upper left-hand corner that there is an outline drawing of the part and that the various surfaces to be finished are each given a letter. With this arrangement the description of the operation can be stated in such manner that there can be no chance for error as to which portion of the piece is referred to in any given operation. The method of locating and holding is distinctly specified, and when used in connection with the free-hand-sketch

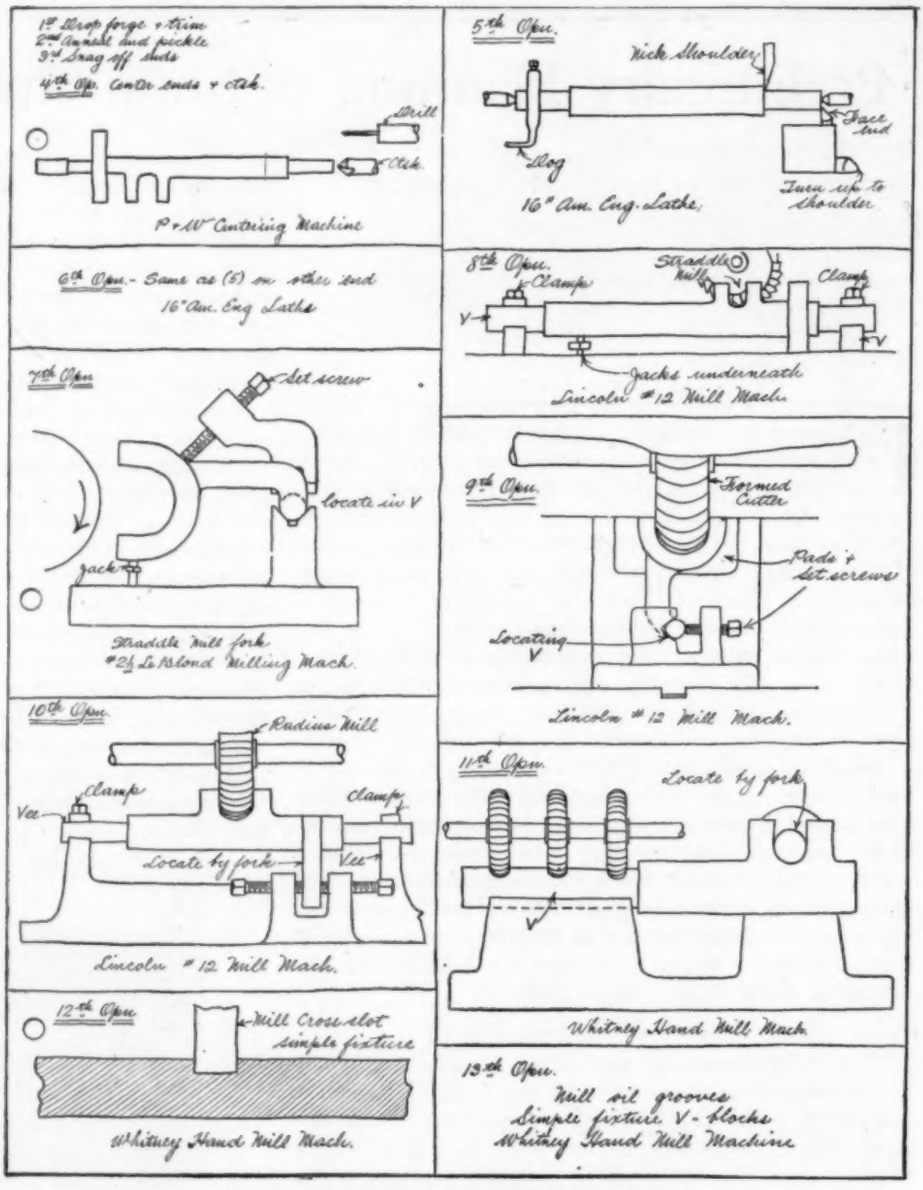


FIG. 12. TENTATIVE FREE-HAND LAYOUT

sheet it is self-explanatory. The type of machine is shown in one column and the department in which the work is done in another. Tools, jigs and fixtures have a column of their own, and adjoining is a space for the drawing number of the tool. The gages are handled in like manner. A column is provided for the estimated hourly production per machine and the percentage of machines required to turn out a given daily production. The production figure and machine percentage are useful in determining what part of a machine's time is necessary to produce a piece of work in specified quantities. By referring to this figure the production engineer can arrange his routeing to best advantage. At the left is a column containing numbers which refer to the large-scale layout sheets, Fig. 14.

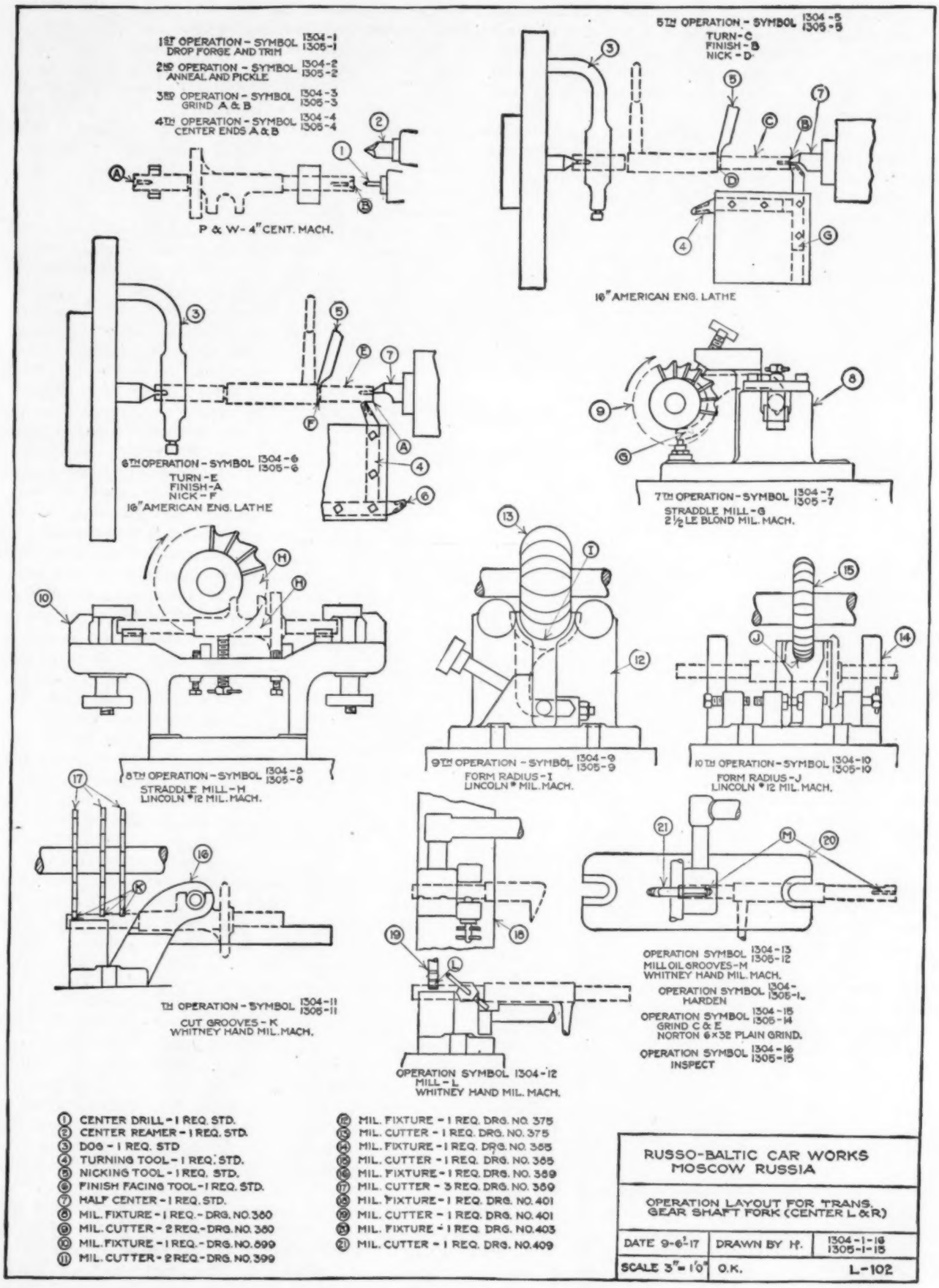
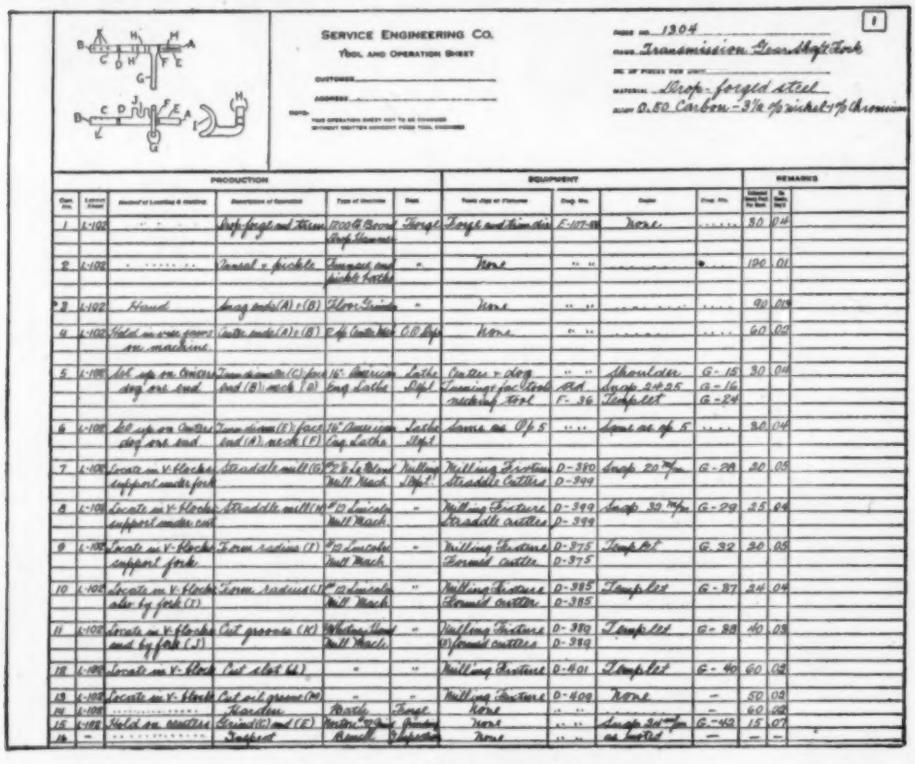

1ST OPERATION - SYMBOL 1304-1 1305-1
DROP FORGE AND TRIM
2ND OPERATION - SYMBOL 1304-2 1305-2
ANNEAL AND PICKLE
3RD OPERATION - SYMBOL 1304-3 1305-3
GRIND A & B
4TH OPERATION - SYMBOL 1304-4 1305-4
CENTER ENDS A & B
P & W - 4" CENT. MACH.
5TH OPERATION - SYMBOL 1304-5 1305-5
TURN - C
FINISH - B
NICK - D
16" AMERICAN ENG. LATHE
6TH OPERATION - SYMBOL 1304-6 1305-6
TURN - E
FINISH - A
NICK - F
16" AMERICAN ENG. LATHE
7TH OPERATION - SYMBOL 1304-7 1305-7
STRADDLE MILL - G
2½ LE BLOND MIL. MACH.
8TH OPERATION - SYMBOL 1304-8 1305-8
STRADDLE MILL - H
LINCOLN #12 MIL. MACH.
9TH OPERATION - SYMBOL 1304-9 1305-9
FORM RADIUS - I
LINCOLN #12 MIL. MACH.
10TH OPERATION - SYMBOL 1304-10 1305-10
FORM RADIUS - J
LINCOLN #12 MIL. MACH.
11TH OPERATION - SYMBOL 1304-11 1305-11
CUT GROOVES - K
WHITNEY HAND MIL. MACH.
OPERATION SYMBOL 1304-12
MILL - L
WHITNEY HAND MIL. MACH.
OPERATION SYMBOL 1304-13 1305-12
MILL OIL GROOVES - M
WHITNEY HAND MIL. MACH.
OPERATION SYMBOL 1304- 1305-1
HARDEN
OPERATION SYMBOL 1304-15 1305-14
GRIND C & E
NORTON 6×32 PLAIN GRIND.
OPERATION SYMBOL 1304-16 1305-15
INSPECT
1 CENTER DRILL - 1 REQ. STD.
2 CENTER REAMER - 1 REQ. STD.
3 DOG - 1 REQ. STD
4 TURNING TOOL - 1 REQ. STD.
5 NICKING TOOL - 1 REQ. STD.
6 FINISH FACING TOOL - 1 REQ. STD.
7 HALF CENTER - 1 REQ. STD.
8 MIL. FIXTURE - 1 REQ. - DRG. NO. 360
9 MIL. CUTTER - 2 REQ. - DRG. NO. 360
10 MIL. FIXTURE - 1 REQ. - DRG. NO. 699
11 MIL. CUTTER - 2 REQ. - DRG. NO. 399
12 MIL. FIXTURE - 1 REQ. DRG. NO. 375
13 MIL. CUTTER - 1 REQ. DRG. NO. 375
14 MIL. FIXTURE - 1 REQ. DRG. NO. 365
15 MIL. CUTTER - 1 REQ. DRG. NO. 365
16 MIL. FIXTURE - 1 REQ. DRG. NO. 389
17 MIL. CUTTER - 3 REQ. DRG. NO. 389
18 MIL. FIXTURE - 1 REQ. DRG. NO. 401
19 MIL. CUTTER - 1 REQ. DRG. NO. 401
20 MIL. FIXTURE - 1 REQ. DRG. NO. 403
21 MIL. CUTTER - 1 REQ. DRG. NO. 409
RUSSO-BALTIC CAR WORKS
MOSCOW RUSSIA
OPERATION LAYOUT FOR TRANS. GEAR SHAFT FORK (CENTER L & R)
DATE 9-6-17
DRAWN BY H.
1304-1-16 1305-1-15
SCALE 3" = 1'0"
O.K.
L-102

FIG. 14. THE FINAL LAYOUT SHEET

In some factories it may be desirable to add another column or two; for example when a firm has its tools and gages made by outside builders additional columns may show what manufacturer is building a particular tool or fixture, together with the date of order and completion.

Though some manufacturers consider layout sheets wasteful, and admitting that under certain circumstances work can be profitably produced without them, nevertheless in large-scale production layout sheets of the kind shown in Fig 14 are invaluable. In connection with them many manufacturers use an instruction sheet for the factory which is a helpful innovation. This will be taken up later in this article. It will be noticed that the sheet itself forms a complete record of all the work done on the piece from the drop-forging to the completed part, the idea being to give a diagrammatic representation of the progression and method of operation, without attempting to show fixtures and cutting tools in detail. Another feature of this sheet is that it may carry a list of all tools used on the work, together with drawing numbers and other information. Such a list will be seen on the lower part of the sheet illustrated, and all tools or appliances used throughout the work are numbered in reference to this list. Certain classes of work cannot be laid out to advantage until after the design of tools has been perfected, but in most cases preliminary work can be done as suggested.



SERVICE ENGINEERING CO.
TOOL AND OPERATION SHEET

PIECE NO. 1304
NAME Transmission Gear Shift Fork
MATERIAL Drop-forged steel
0.50 Carbon - 3% of nickel - 1% of chromium

PRODUCTION						EQUIPMENT				REMARKS	
Oper. No.	Layout Sheet	Number of Locating & Clamping	Description of Operation	Type of Machine	Dept.	Name, Size or Number	Drawing No.	Gages	Drawing No.	Estimated Time in Hrs. per 100	No. Men Req'd
1	L-102	—	Drop forge and trim	1200 lb Board Drop Hammer	Forge	Forge and trim die	E-107-B	None	.....	50	04
2	L-102	—	Tumble + pickle	Tumbler and pickle baths	"	None	" "	———	———	100	01
3	L-102	Hand	Drag ends (A) & (B)	Hor. Drilling	"	None	" "	———	———	90	03
4	L-102	Held in vise, gripping on machine	Cut ends (A) & (B)	2 sp. Cutoff Mach.	C.H. Dept.	None	" "	———	———	60	02
5	L-105	Set up on Center stop and end	Turn diameter (C) face end (B) and (D)	16" American Eng. Lathe	Lathe Dept.	Center + dog Turning fixture Facing tool	" " A-24 F-36	Shoulder Snap 2.425 Templet	G-15 G-16 G-24	30	04
6	L-105	Set up on Center stop and end	Turn diam (E) face end (A) and (F)	16" American Eng. Lathe	Lathe Dept.	Same as Op 5	....	Same as op 5	.....	30	04
7	L-106	Locate on V-Blocks support under fork	Straddle mill (G)	2-No 2 B & S Vert. Mill Mach.	Milling Dept.	Milling Fixture Straddle Cutters	D-380 D-399	Snap 2.0 Max	G-29	20	05
8	L-106	Locate on V-Blocks support under end	Straddle mill (H)	2 Lincoln Mill Mach.	"	Milling Fixture Straddle cutters	D-399 D-399	Snap 3.2 Max	G-29	25	04
9	L-105	Locate on V-Blocks Form radius (I) support fork		2 Lincoln Mill Mach.	"	Milling Fixture Formed cutter	D-375 D-375	Templet	G-32	30	05
10	L-105	Locate on V-Blocks side by fork (J)	Form radius (L)	2 Lincoln Mill Mach.	"	Milling Fixture Formed cutter	D-385 D-385	Templet	G-37	24	04
11	L-106	Locate on V-Blocks and by fork (J)	Cut groove (K)	Whitney Hand Mill Mach.	"	Milling Fixture 2 Formed cutters	D-389 D-389	Templet	G-38	40	05
12	L-105	Locate on V-Block	Cut slot (M)	"	"	Milling Fixture	D-401	Templet	G-40	60	02
13	L-105	Locate on V-Block	Cut out groove (N)	"	"	Milling Fixture	D-409	None	—	50	03
14	L-105	.....	Hardening	Rotary	Forge	None	" "	———	—	60	02
15	L-102	Held on centers	Grind (C) and (E)	Norton "Crown" Grinder	Grinding Inspection	None	" "	Snap 2.0 Max as limited	G-42	15	07
16	—	.....	Inspect	Bench	"	None	" "	———	—	—	—

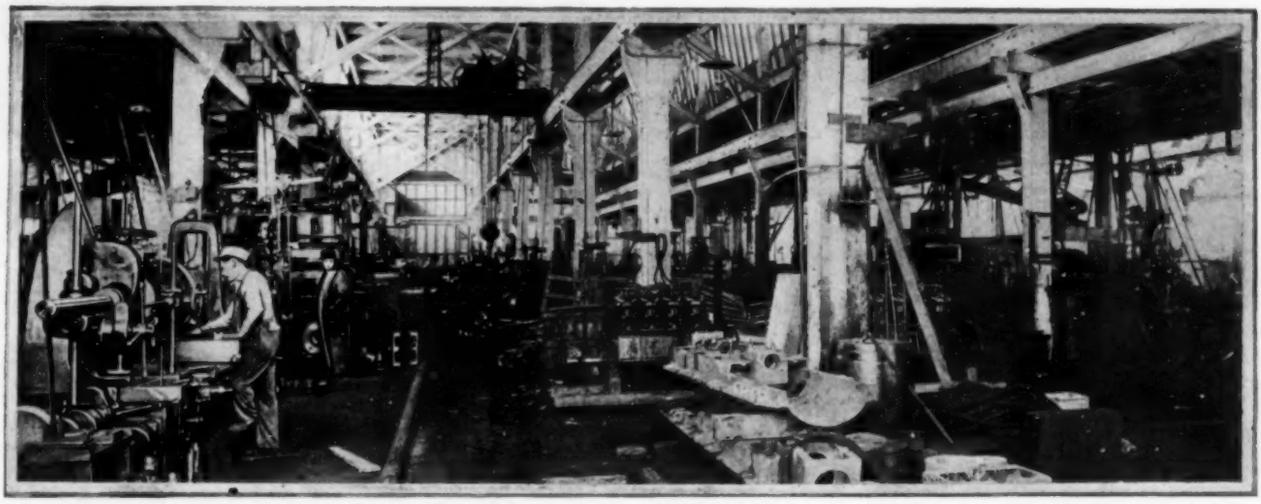
FIG. 13. THE OPERATION SHEET

On turret-lathe or screw-machine work the advantages of a layout sheet are apparent because of the possibility of interferences between the turret and cross-slide tools, and it is desirable to have the work done by a thoroughly practical turret-lathe tool designer. There are so many points of interference to look out for and so many combinations of tools for producing the work advantageously that it is necessary for the draftsman to be perfectly familiar with it.

The same method of procedure is used in laying out tools for the turret lathe as in other machining operations. It is, however, advisable to show the tools in the turret faces and also in operation. Tools which are in use at the same time on the outside and inside of a piece of work should be shown in the relative positions they are in when the operation is in process. In this way chance for interferences will be obviated and the tooling can be arranged satisfactorily.

The advantage of making tool layouts for turret-lathe work lies in the ease with which the operator can set up his work without using the cut-and-try method. A blueprint of the tool layout can be sent to the shop before the work has been started and the operator can use it in setting up. He will see just how the tools can be most suitably arranged and can set them in approximately correct positions by scaling the layout sheet, providing these sheets are made to scale, as they should be. The operator in setting up a turret-lathe job might spend hours in setting tools and adjusting them so as to obtain maximum production, and if the work were planned in advance, as shown by an operation sheet, he has nothing to do but to make his set-up according to the layout given. If it does not produce the work or if he sees a way to save time by changing the set-up he may take the matter up with his foreman. The decision can then be left to the tool engineer. One of the most progressive manufacturers in the country makes tool-layout sheets to quarter-size scale and sends the blueprints to the shop for the operator to use in setting up the machine, and the results show that this arrangement has many advantages. When instruction sheets are used in connection with the tool layouts there is nothing left to be desired. The matter of turret-lathe tooling is of sufficient importance to warrant reasonable expenditure which will tend to take advantage of its possibilities of increased production.

I have recently seen many cases of inefficient tooling of turret lathes in factories producing work for the Government. The attitude of these manufacturers is that the department foreman is capable of specifying methods of setting up the turret lathe to obtain production, and they do not stop to consider that this foreman has so many other things to do that in order to apply scientific methods of tooling to all of his machines it would be necessary for him to work 24 hours a day. The best place to plan the operations and methods of tooling is in the drafting room, and the man who does this planning must be an expert both theoretically and practically.



Gas-Engine Work on the Pacific Coast

By FRANK A. STANLEY

The following description covers certain boring, milling, turning and other operations in the manufacture of a line of well-known stationary and marine gas engines. Work on bases, crank cases, pistons, crankshafts, etc., is described and a number of special fixtures illustrated.

THE Atlas Imperial Engine Co., of Oakland, Calif., builds a complete line of stationary, portable and marine engines, hoisting engines, etc., designed for operation with gas, gasoline or distillate, and constructed in one, two, three and four cylinder units ranging in capacity up to several hundred horsepower.

The shops of this concern are so situated as to have ample yard area, and the free outlook in every direction, in conjunction with the almost continuous rows of window lights along the side and end enclosures as well as along the monitor roof, assures the best of natural-lighting conditions at all seasons of the year. This feature is most noticeable in the general view of one of the shop bays in the headpiece, where the main machine aisle under the overhead crane is shown for about two-thirds of its length, and the window area in side walls and monitor are well represented. This interior view conveys some idea of the general character of the machine equipment.

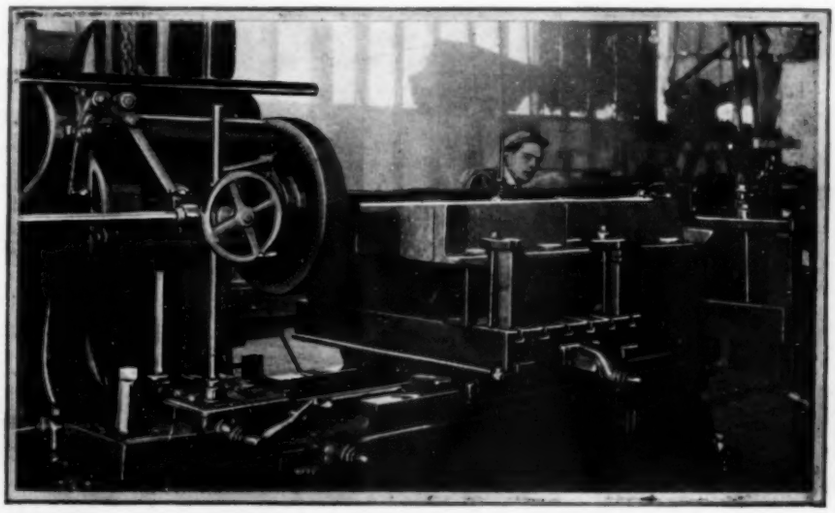


FIG. 2. BORING THE BEARING SEATS IN AN ENGINE BASE

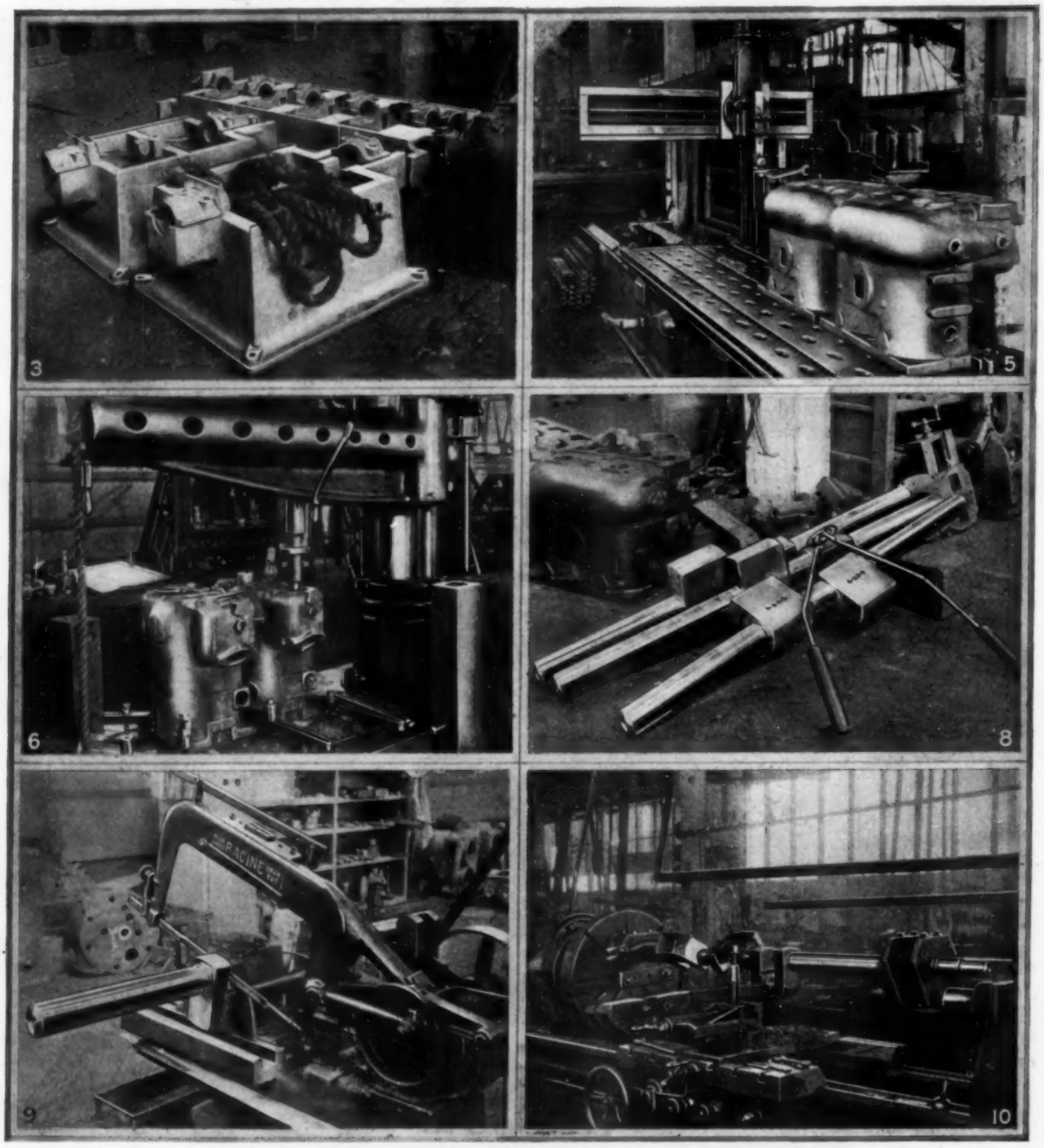
The machine to the left of the foreground in the headpiece is a horizontal boring mill, set up for operations on a large engine base casting. A closer view of the machine and work is reproduced in Fig. 2. In Fig. 3 a similar casting is shown on the floor.

Before the casting is brought to the horizontal boring machine it has been planed on the top surface, along the underside of the longitudinal flanges or supporting webs, and across the tops of the bosses for the holding-down bolts and nuts. As its length exceeds that of the boring-machine table by 3 or 4 ft., a pair of long parallels are used for carrying the casting which lift its bottom clear of the table, extend outwardly to an auxiliary member mounted upon floor jacks and provide uniform support for the work at every point in its length. The base casting is set accurately for the boring operation by means of a surface gage which is applied from each side to check up the parallelism of the work in respect to the boring bar and to test the height of the bar itself in relation to the faced upper surface of the casting to determine if it will bore the bearing seats centrally with this face. The base shown on the boring machine is for a three-cylinder, 12 x 12-in., 100-hp. marine gas engine, and differs from the engine case on the floor in Fig. 3 only in respect to length, the latter being for a four-cylinder engine of exactly the same type but of correspondingly higher power. The arrangement of the bear-

ings will be understood from the illustration, Fig. 4, where a four-throw crankshaft is seen in place with the caps in position with the exception of the two for the outer throw to the right.

From this illustration it will be gathered that a bearing is provided for every crank and that each crank has a separate compartment in the base adapted to hold heavy oil for splash lubrication. The crankshaft for this size of engine is 4½ in. in diameter, and the seats in the base for the bearings are bored out to 5¾ in. The bearing boxes are made of special bronze, and after they are fitted into the bored seats they are scraped accurately to alignment.

The boring operation is usually accomplished by taking three cuts through the work. Ordinarily there is about ⅛ to $\frac{3}{16}$ in. of metal all the way round to be removed from the cored seats, though in some cases this is increased somewhat on one side or the other. In the first boring cut the opening is enlarged to within about $\frac{1}{16}$ in. of desired diameter; the second cut removes all



FIGS. 3, 5, 6, 8, 9 AND 10. MACHINE OPERATIONS

Fig. 3—Base for four-cylinder marine gas engine. Fig. 5—A set of cylinders on the planing machine. Fig. 6—Boring valve-seat openings in the cylinder head. Fig. 8—Partly finished crankshafts. Fig. 9—Cutting out crank webs on the power hacksaw. Fig. 10—Special crankshaft fixtures in lathe

but about $\frac{1}{64}$ in., and this provides enough material on each side for a suitable finishing cut, which is taken with a fairly coarse feed.

The illustration shows among other features the automatic ring oilers for the bearings which receive the

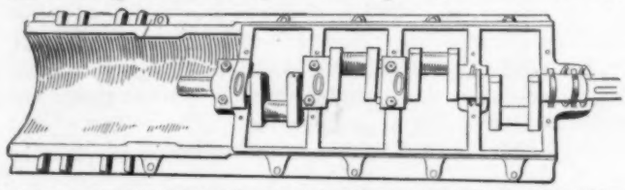


FIG. 4. ARRANGEMENT OF CRANKSHAFT BEARINGS AND BASE COMPARTMENTS

lubricant from a chamber below the shaft; it also gives an idea of the great length of main bearings, which aggregate ten times the diameter of the shaft.

Along the top of the base casting will be noticed the finished surface that forms the lower joint for the crankcase proper. This consists of an integral rectangular frame for inclosing all the working parts of the engine with the exception of the pistons and valves. The top of the crankcase is adapted to receive the cylinders, and each side of the case is fitted with doors to give easy access to the interior. The cylinders, as indicated in Fig. 5, which shows these parts for another size of engine, are cast with heads as an integral part. The work under way on the open-side planing machine consists in surfacing and finishing the top faces of the cylinders to receive the brackets for the ignition apparatus, etc. These cylinders are a pair of double units for a 20-hp. engine, and they are carried along through successive operations simultaneously wherever feasible, as in planing and the like. They have already been finished on the bottom or open ends before arriving at the stage indicated in the illustration. The planing operation represented here is followed by the boring of the cylinders and various other drilling and boring operations.

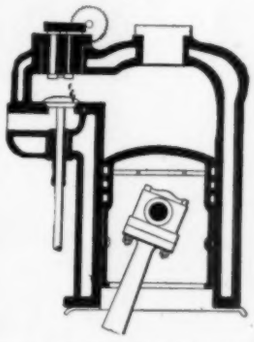


FIG. 7. SECTION THROUGH CYLINDER AND HEAD

An operation in the radial drilling machine is shown in Fig. 6 with the machine at work boring the openings in the head and valve chamber for the valve itself; in the stem guide, and in the igniter hub in the top of the head. The arrangement of cutters will be understood from the illustration. The relative positions of the openings to be bored are shown in Fig. 7.

The cutters used in the boring bar are flat, double-ended affairs placed one above the other at suitable distances and spaced approximately at thirds around the bar circumference. The lower cutter bores the valve-stem guide; the intermediate, the valve seat, and the upper cutter the enlarged hole for the igniter at the top of the head.

Two sets of cutters are used for roughing and finishing operations. Final alignment of the valve seat and guide-bush hole is secured by application of a seating reamer on a bar piloted in the finshed bushing seat. The second or finish cuts in such boring operations are quite light whether or not they are to be followed by a reaming process, as it is important that the finish cut shall bring the holes into practical alignment through having not more than about $\frac{1}{64}$ in. of stock to remove.

The application of an adjustable stop collar to the boring bar enables the depth of the valve seating cut to be regulated as desired.

Some features of the practice in handling cranksharts are illustrated in Figs. 8, 9 and 10. Fig. 8 shows the shafts with their bodies turned down and the throws faced on the sides of the webs; also with a series of holes drilled through the webs at the bottom of the gap which is to be cut out before the turning of the pins can be started.

There are four $\frac{1}{2}$-in. holes drilled through each web, these being spaced so closely together that they prac-

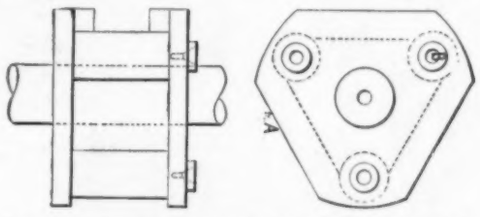


FIG. 11. DETAIL OF CRANKSHAFT CENTERS

tically break into one another and leave little cutting to be done in removing the block of waste material from the web. This drilling is of course preliminary to the process of cutting out the block of steel in the web to prepare it for the facing of the inside of the throws and the turning of the crankpin.

For a small shaft of the character indicated an ordinary power hacksaw is used in the blocking-out process, as presented in Fig. 9. The work is so set in the saw vise as to assure sufficient stock being left at the sides for satisfactory facing of the inner web surfaces, and the saw blade then does the rest without attention from anyone until the bottom of the cut is reached and the work requires readjusting for the second cut.

The sling or grab hook seen in Fig. 8 is simply a pair of long hooked arms with a length of rubber hose over the ends to prevent direct contact with the work surface. The hooks have sufficient span to balance a long, heavy shaft, and they have proved worthy of use throughout the plant.

The method of turning crankpins in the lathe is illustrated in Fig. 10, which shows clearly the type of

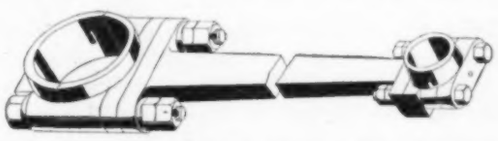


FIG. 14. HOW THE CONNECTING-ROD AND BOXES ARE PUT TOGETHER

fixture used at each end of the shaft for throwing it off center sufficiently to bring the crankpins into central position for turning.

The crankshaft in the lathe is for a three-cylinder engine, and its three pins are located 120 deg. apart. The turning fixtures are therefore constructed to give three different positions for the work on the lathe centers to correspond with the desired center locations of the crankpins.

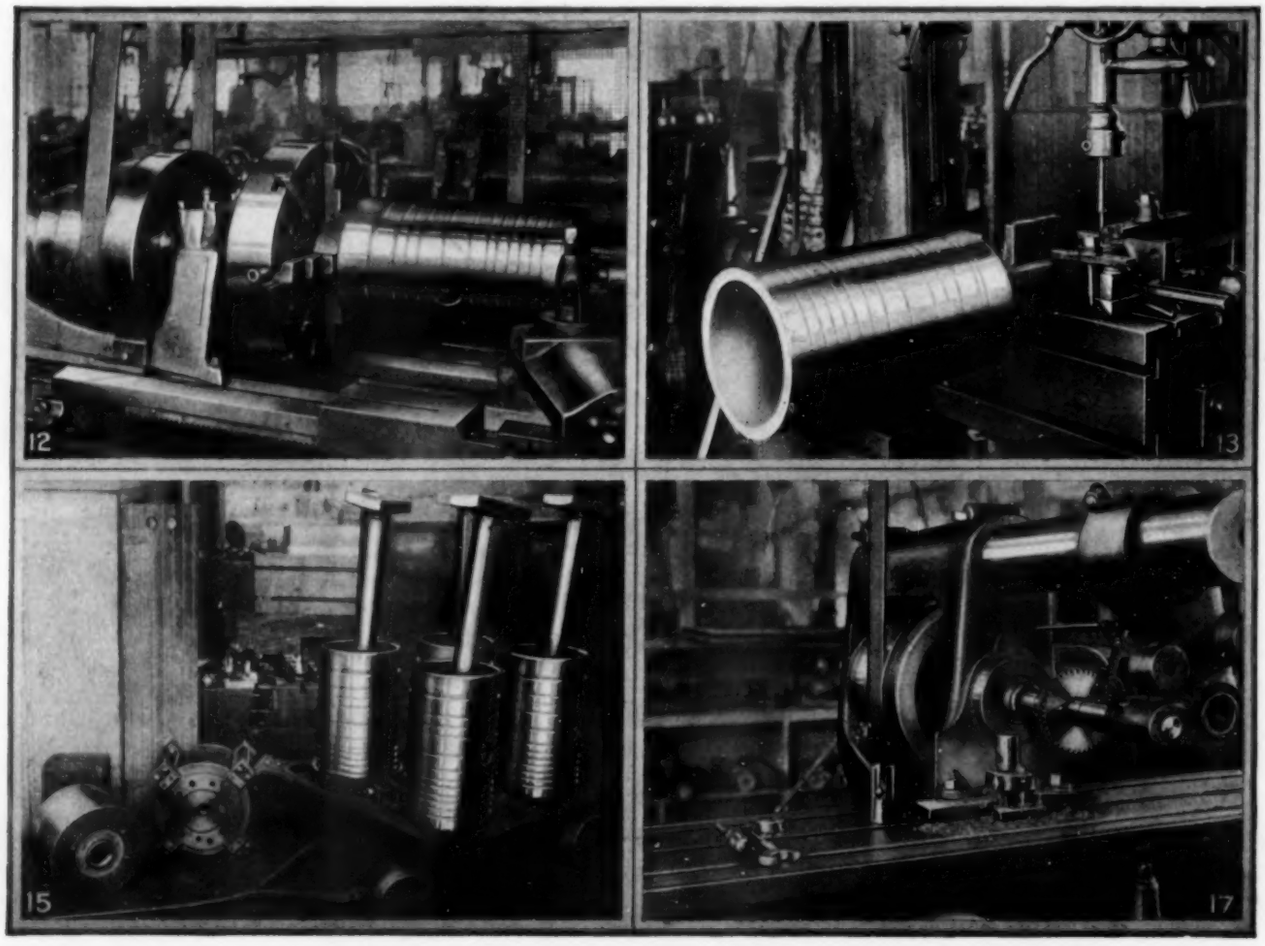
The fixtures, as shown in the illustration and in Fig. 11, are special forms of offset centers, of a triangular outline, equipped with clamp bolts for securing them to the shaft and carrying three properly countersunk centers, one for each of the three positions they must occupy on the lathe centers. The illustration merely shows the outline of the fixtures and the relative position of shaft and centers. The method of securing the work in place is by straps and bolts as shown in Fig. 10.

As the center fixtures are triangular in form they are readily lined up on the crankshaft as any one of the three faces may be used on a bench plate to bring the pair of fixtures into correct alignment. The cranks can be brought into proper relative positions with the center holes by turning the shaft over until one of the crank webs stands perpendicular; that is, at a right angle to the flat lower edge of the fixtures, and therefore in line with the centers at the opposite edge of the fixtures. If the fixtures rest on face *A*, Fig. 11, and the shaft is turned until one of the webs is perpendicular to the bench plate its pin must necessarily be in alignment with the centers *B*. When the crankshaft is thus set with one of its pins properly positioned for turning, the other two are bound to be in correct positions.

The pistons used in these engines are fitted with regular snap rings, have splash oil rings, and are designed with crowned tops to obviate the possibility of cracking under expansion and to prevent carbon from remaining upon their tops and the consequent necessity for removing them for cleaning.

One of the pistons for a marine engine is shown in the lathe, Fig. 12, with the upper end undergoing finishing operations. The piston is carried by a center at this end and at the other by a plug, which is grasped by the four-jaw chuck. The positions of the ring and oiler grooves are shown and the piston is about ready for the reception of the connecting-rod.

One of the pistons with rod and wristpin in place is shown in Fig. 13 under the drilling machine, where some small holes are being drilled in the side of the rod as indicated. These rods are of rectangular cross-section forged from the solid bar and have bearing boxes which are secured to the rod ends by two fitted bolts with locknuts and cotter pins. This construction is shown in Fig. 14.



FIGS. 12, 13, 15 AND 17. MACHINING THE PISTONS

Fig. 12—Turning the piston in the lathe. Fig. 13—A connecting-rod and piston in the drilling machine. Fig. 15—A set of pistons and a drill jig for reversing gears. Fig. 17—Milling slots in tappets

Before the boxes are bolted on, the rods are readily machined, being milled, planed and turned to contour and faced across the ends on centers to receive the flat boxes. The holes for the body-fit box bolts are drilled in jigs and reamed accurately to size and alignment and the boxes are similarly jigged and the through holes reamed for the reception of the bolts.

The crankpin boxes are fitted with bronze bearings. With the bolted-on construction for the boxes it is a

simple matter if one of the pistons ever requires to be removed to take out the bolts from the crankpin box and then lower the piston until it rests on one of the crank webs, after which, by a slight turn of the shaft, the piston can be taken directly out through one of the doors in the side of the crankcase.

In Fig. 15 a group of pistons with rods of this design is shown ready for assembling, the crankpin boxes still remaining to be put in place.

At the left side of the truck may be seen a drill jig for use on the reversing gear for marine engines, and

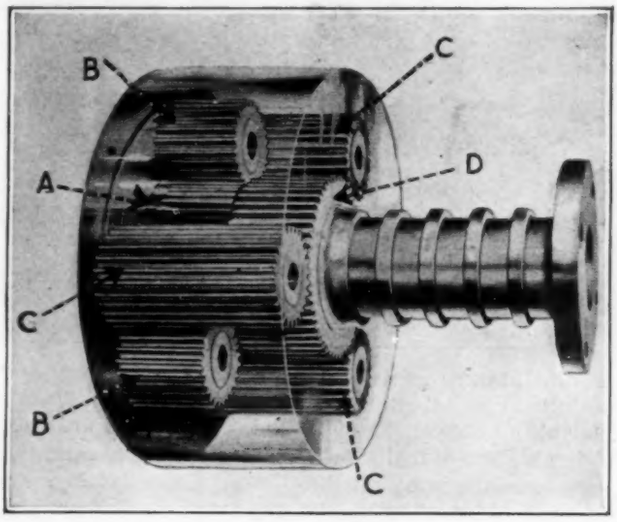


FIG. 16. CONSTRUCTION OF REVERSING GEAR FOR PROPELLER

to the left of the jig is one of the gear casings itself, all assembled. This jig is built up of a pair of circular plates on four standards or ties, between which the work is secured for drilling and reaming operations.

In the reverse gear for these engines there are six pinions spaced about the central gear. The gears are located as shown in Fig. 16. They are made from steel forgings, and all of the pinions are provided with bronze bushings, the entire series of gears being inclosed in an oil-tight casing which, when filled with oil, provides a continuous oil bath.

The gear arrangement is of interest as it gives the propeller the same rate of speed astern as when running ahead. The go-ahead drive is by means of a friction clutch of the multiple-disk type, which admits of adjustment by loosening a single bolt and screwing around a clamp collar. The gear case is a plain cylindrical affair, which when the reverse lever is operated is prevented from rotating by a pair of clamp shoes, or brakes, which are actuated by a powerful screw-and-toggle motion; at the same time the friction clutch is released.

The reverse drive is then through the gears and pinions as follows: The power from the engine is transmitted through the shaft to the spur gear A which, when the case is prevented from turning by the clamps before mentioned, drives three short pinions *B* (two of which may be seen in the cut), and these drive the long pinions *C* which mesh with the gear *D* upon the propeller shaft. The reverse direction of rotation therefore occurs between pinions *B* and *C*.

Referring again to Fig. 15, another feature of interest in connection with the handling of the piston operations is the split clamp shown on the end of the piston at the front of the truck. This is a type of clamp employed on various sizes of work of this character for facilitating the handling of the parts about the shop and in and out of certain machines. It is of especial service on large and heavy pistons which have been finished externally but which have to be put under drilling or other machines for certain work.

The clamps are drawn together to hold tight on the piston and then are far enough apart at their ends to admit the hook of a hoist under the clamp bolts so that the whole affair can be picked up without effort by slinging or securing with chain or rope, and when so slung can be easily handled vertically, horizontally or otherwise as desired without bruising the surface.

A slotting operation on small work is illustrated in Fig. 17. The pieces machined are the tappets for the valve stems, and they are slotted at one end to receive the rollers which engage with the cams for controlling the valves. The parts are turned first to diameter and then drilled to form the bottom of the slot, which is afterward milled out with a pair of saws.

The work is held in a fixture which is bored to receive the tappet and which is split across the body so that it may be gripped tight on the work when its clamp is set up by the screw shown. The two saws are spaced the proper distance apart, and when fed through the work at a moderate rate of speed they produce a slot of the desired width, which is true and straight in spite of the depth of the cut and the comparatively narrow edges of the cutters.

A Flare for Aviators

An airplane flare with a brilliancy equalling that of 400,000 candles has been perfected. When hanging from its parachute over a German munition plant it lights up an area so brightly that an airman thousands of feet in the air can select any building he is directed to make a target for his aerial bomb. Having reached the particular district sought, he must locate the particular object of his attack from his position, which may be 5000 or 10,000 ft. or even higher, above the earth. Equipped with the airplane flare the aviator pulls a lever and releases it. As it drops, the resistance offered by the air sets the fuse mechanism in operation. The result is the emission of a powerful light of from 300,000 to 400,000 cp., which completely illuminates the terrain below. The amount of light given is equal to that of a battery of from 150 to 175 street arc lamps or of from 15,000 to 17,500 ordinary incandescent-lamp bulbs such as are used in the home. As soon as the flare gets into operation a huge parachute made of the best quality of silk opens and holds the brilliant light in suspension in the air for a sufficient time to allow the aviator to select his objective or target. Having located the factory, railroad depot, ammunition dump, hangar, munition plant, or whatever the target may be, the aviator drops the bomb and proceeds on his way. An idea of the effective light thrown on the ground by this flare may be gained from the fact that when suspended at a height of from 1500 to 2000 feet it will clearly light a circular area 1½ miles in diameter.

Making Cylinders *for* Destroyers

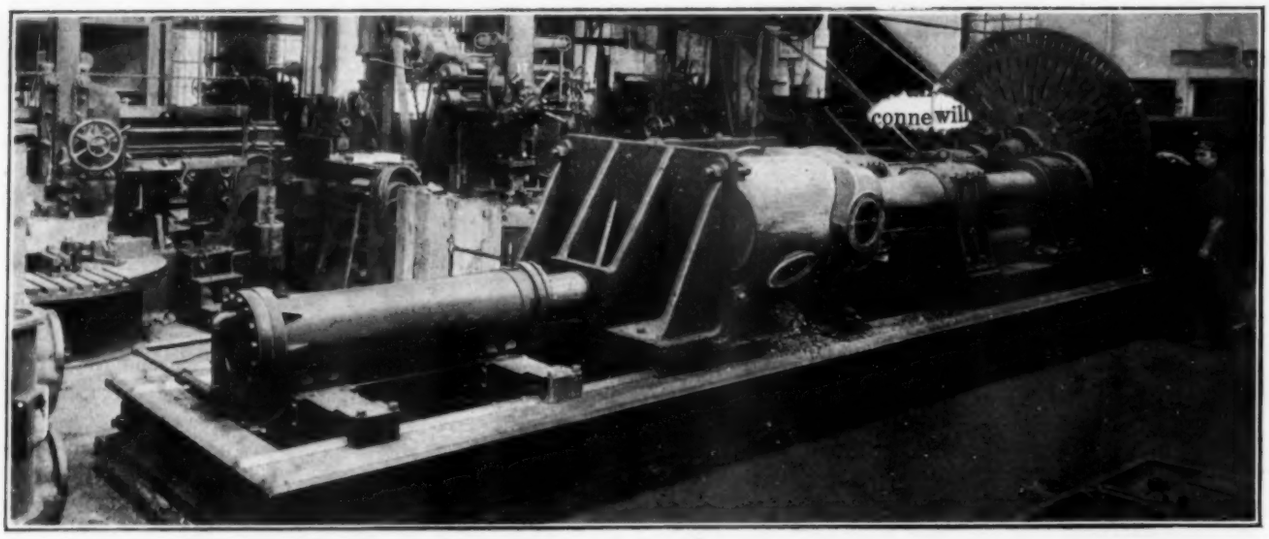


FIG. 1. THE HYDRAULIC FEED ON BORING LATHE

THROUGH the courtesy of the Blake & Knowles Works of the Worthington Pump and Machinery Corporation and the Navy Department the two illustrations here presented depict some interesting work on air-pump cylinders for the new destroyer program recently decided upon.

These illustrations were taken several months ago and show the first pair of these cylinders being bored on a large Putnam lathe which, as can be seen, was converted into a duplex boring machine. These twinplex air cylinders are 30 and 24 in. in diameter respectively.

The special double head was made for carrying the boring bars, each bar being supported in two substantial bearings and having a suitable boring head with adjustable cutters at the outer end. These bars are fixed at the right center distance and are driven by a central gear from the lathe spindle. The cylinder castings are clamped to another special head or carriage, which moves along the ways of the lathe under control of the hydraulic cylinder shown in the upper view.

This makes a very substantial horizontal boring machine with two bars and has worked out very satisfactorily. The castings shown at the end of the lathe give some idea of the work to be done, and these are only a beginning. With a destroyer program of this kind it is obvious that the submarine has mighty little chance of preventing our boys from reaching the other side in even larger numbers than have previously gone.

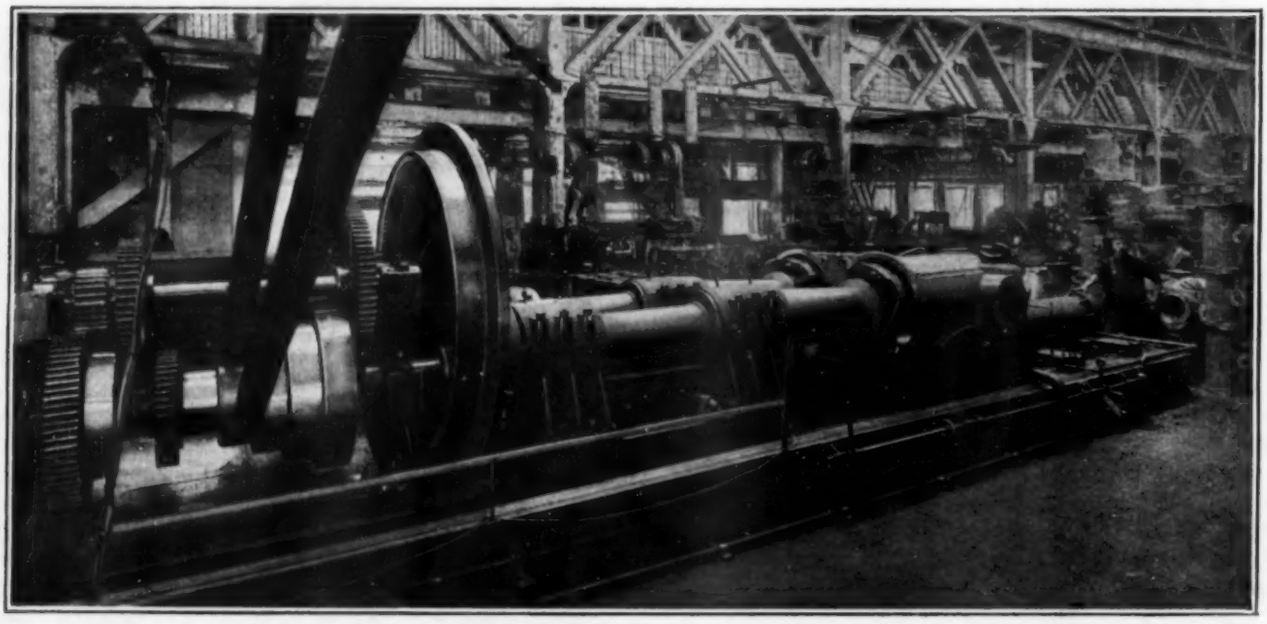


FIG. 2. PUTNAM LATHE WITH DOUBLE BORING ATTACHMENT

Elimination of Chatter Marks From Machined Work

SPECIAL CORRESPONDENCE

The tool marks which appear on finished surfaces, due to the chattering of the tool, are an annoying feature when good work is desired; besides it puts an unnecessary amount of wear on the tool. In this article the author describes some of the main causes of this trouble and the means that were taken to eliminate them.

THE effect of vibration on tool cuts is one of the most troublesome things in machine-tool work. It may be caused by different things, and it produces a series of marks generally termed "chatter marks."

Chatter marks may be found on many varieties of work to a greater or less extent, and are produced by all kinds of machines—lathes, milling machines, shaping machines, planing machines, vertical boring mills and even drilling machines. No matter what the cause of the vibration may be it should at once be looked into and a remedy applied, because trouble of this kind is injurious both to the tools and the machines. Besides chatter marks do not improve the appearance of the product either from a mechanical or a commercial standpoint.

So many things contribute to the production of chatter in mechanical work that it is obviously out of the question to treat the subject in any other way than by mentioning specific cases and suggesting remedies which have proved effective. A great deal depends upon the conditions under which the work is being done. Sometimes the tool may be at fault; at others it may be the method of holding, and in still others the machine tool itself may be the principal cause of the trouble.

In order to prevent faulty work caused by chatter we must analyze the conditions that obtain when the trouble occurs, and when it has been discovered we can then apply the remedy. It is impossible for anyone to say offhand what causes chattering on a certain machine; but a man of wide mechanical experience, who has personally operated various machine tools and has analyzed and remedied machine troubles can generally locate chattering quicker than one whose work has been confined to a few types of machine. Every possible cause that might be responsible must be thought of and considered, and the things which are the most likely to be the cause are naturally the first to be considered.

Chatter on Engine Lathes and Turret Lathes

Chatter occurs occasionally on the engine lathe due to improper adjustment of the gibs or some other part of the machine. Fig. 1 illustrates an example of this kind, in which the work *A* is held by the outside in the jaws of a regular three-jawed chuck mounted on a faceplate which is screwed to the spindle end in the ordinary way. In this instance, when the facing cut was being taken with the tool *C* on the cross-slide of the lathe, it was found that there was a slight tendency to chatter when the finishing cut was being made, although no trouble was noticed during the roughing operation. The cause was found to be a slight end play in the spindle *B*, which allowed the work to move slightly away from the point of the tool in travel when a light cut was being taken, so that there was a tendency to glaze. Hence the tool would slide over the work for a part of a revolution perhaps and then take hold again for a moment, thus causing a slight chatter. After the end play had been taken up in the spindle no more trouble was experienced on this piece of work.

Pronounced chatter may sometimes be caused by a slight looseness in the front cap, shown at *D* in the illustration, this being easily remedied by "setting down" the cap enough to take up the lost motion.

Another cause of the trouble on facing work is the shape of the tool and its angle as presented to the work. Taking the same piece of work as in the illustration, and using a tool shaped like *E* for doing the roughing work, much annoyance might be experienced on account

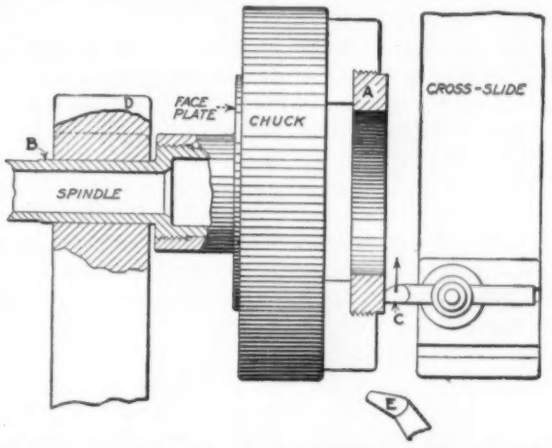


FIG. 1. SPINDLE PLAY CAUSES CHATTER MARKS

of the spring of the tool which, from its shape, would naturally dig into the work when fed radially toward the center. It is always advisable to set the tool in such a way that any spring will tend to throw it away from the work rather than into it. Gooseneck tools of all kinds employ this basic principle, but it is by no means necessary to use a gooseneck tool for all work of this kind, as the principle can be applied as well in many instances without requiring its use. In facing work it is advisable to set the tool above center in order to obtain the effect of a shearing cut; the stock then will be removed more easily and with less likelihood of chatter.

Chatter is sometimes apparent in boring small bushings, and is the cause of a great deal of trouble because of its destructive action to the tool point and the resultant inaccuracy of the work. Let us take as an example the piece of work *A* shown in Fig. 2. This is a bronze bushing which has not been machined in any way prior to the operation shown. The hole has been cored and is therefore in a rather bad condition to attack with

a tool on account of the burned sand, scale, etc., with which it is lined. In boring a bushing of this kind on a lathe the ordinary method would be to hold it in a set of jaws by the outside portion and bore it out with a type of tool similar to that shown at *D* in the illustration. It will be seen that the point, or cutting edge, of the tool *C* has a bevel which tends to "ride" on the scale as it enters the work. When the extended portion is rather long this is more apparent than when the tool can be held short, so that there is little overhang: yet even in a case of this kind objectionable chatter is likely to occur.

One of the causes of chatter in a piece of work like that shown is the fact that the tool springs down under

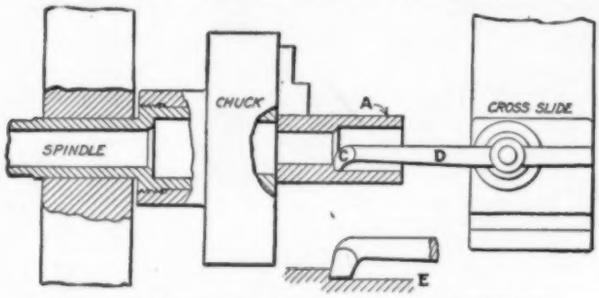


FIG. 2. TROUBLE FROM EXCESSIVE OVERHANG

the cut until it is below center, and on account of the curvature of the work it alternately "digs in" and springs back to position. If the tool be set a trifle above center some of this trouble will be avoided, because instead of digging into the work the tool will spring slightly away from the curvature under the pressure of the cut. A very good way to grind a tool for boring a bushing of this kind is shown at *E*. It will be observed that the end of the tool in this case has a slight angle (about 5 deg. is sufficient), and the result of this angular grinding is to prevent the tool from "crawling up" on the scale and dulling rapidly. Instead of so doing

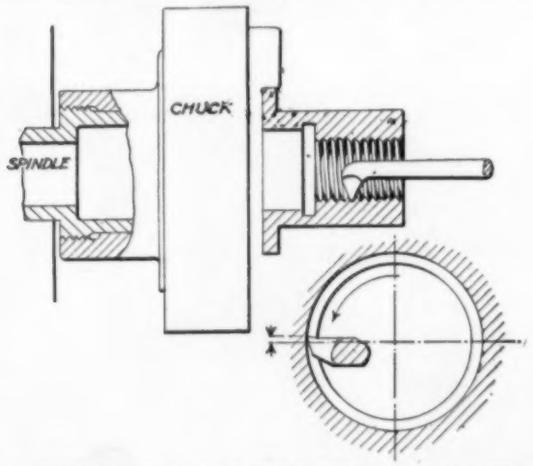


FIG. 3. TOOL SETTING FOR CUTTING INTERNAL THREADS

it has a tendency to keep under the scale so that the cutting edge remains in condition a much longer time. If the tool is ground in this way and is set slightly above center very little chatter will result unless the overhang is excessively long or the feed too coarse.

When internal threaded work is not tapped out but is chased by a single-point tool, chatter is a common occurrence. If the tool used is of the form shown in Fig. 3 it will be found advisable to set it enough above center so that the spring of the tool in cutting will bring the point about to the center line. This is largely a matter of judgment on the part of the operator, and the amount the tool needs to be set above center depends largely on the depth of chip which is to be taken. If placed too far above center a variation will occur in the angularity of the thread for the reason that, when cutting, the tool itself will be really above center, even taking into consideration the "spring," and as a consequence the cutting angle will be slightly different from what it should be.

It is quite important on any threading operation to have the point of the tool very keen, and it should also be stoned until it is smooth. A tool may be keen and sharp and yet it may not give satisfactory results because the edge is too "raw" or "rank."

Work held on centers is less subject to chatter than when held in a chuck with an unsupported end on which

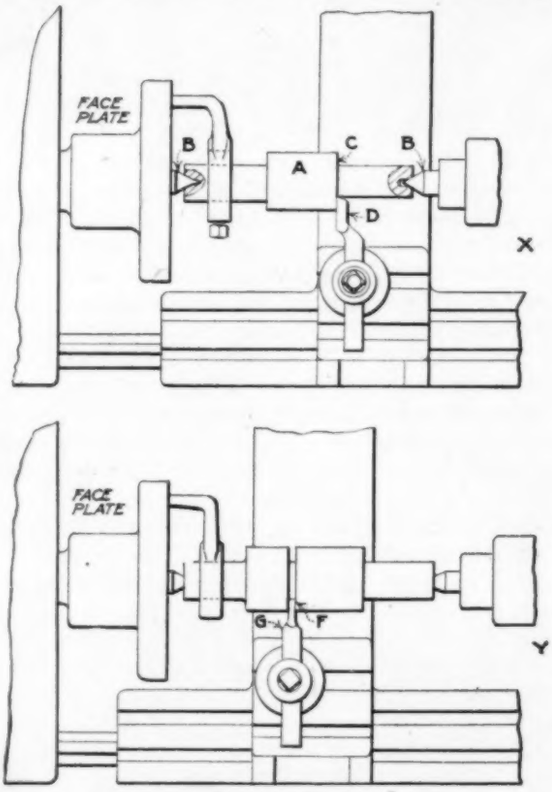


FIG. 4. CHATTER ON WORK BETWEEN LATHE CENTERS

the cut is being taken. End play in the spindle is a frequent cause of small chatter marks on engine lathe work, especially when it is being held between centers. Take the piece of work *A*, for instance, at *X* of Fig. 4, which is held on centers *B* and is being turned and faced at the shoulder *C*. The tool *D* is being used to face up the shoulder and its persistent chatter is very apparent. By tightening the tailstock center the spindle will be crowded over sufficiently to take up end play in the spindle. It may be that the feed which is being used is a trifle too coarse, and as a consequence the tool springs down and digs into the work. Then again, instead of the feed being too coarse it may be too fine, and in such a case instead of the tool cutting evenly and well it takes a fairly good cut at one time and at another does not have

sufficient stock to give it a good hold on the material. As a consequence it rides at times, and at others it takes a trifle too much stock and "digs in." The remedy for chatter of this sort is obvious.

Occasionally it is necessary to cut a groove in a rather long bar such as that shown at *Y*, Fig. 4. In this case the bar is held on centers, as in the preceding instance, and the parting tool *G* is used to groove the work at *F*. In this case chatter may result from several causes: it may be from the spring of the tool itself; from the spring of the bar; from a slight amount of play between centers; from the tool being set a trifle above center; from the use of too much feed, or from the tool being slightly dull. The remedies for each case are self-evident.

Probably nowhere is chatter more prevalent than in milling. Some of its causes on work of this description are as follows: The cutter may run out of true radially so that it takes more stock on one portion of the periphery than on another. Insufficient feed may be

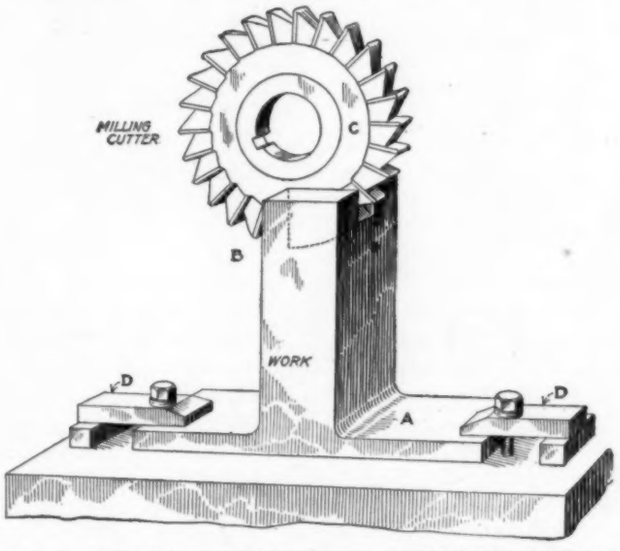


FIG. 5. MILLING PART WITHOUT SUFFICIENT SUPPORT

another cause of trouble, for if the feed is too fine the cutter at one time has too small a quantity of metal to take a good hold upon, while at another it is taking a little too much and has an intermittent tendency to glaze and finally dig in. Too much feed in proportion to the speed is another source of trouble. It should be borne in mind that in order to get results in milling-machine work the speed should be conservative and the feed proportional, an inclination toward coarse feeds and slow speeds being considered good practice.

In heavy cutting on the milling machine chatter is sometimes apparent because the gibs on the table are not taken up sufficiently. Chatter of this kind is seldom found except in "over-and-over" milling and the evident cause is that the table lifts a trifle and then settles back causing a variation in the amount of cutting.

In using an end mill on a milling machine it is possible that a chatter may be found due to a slight end play in the milling-machine spindle.

It is sometimes necessary to use a mill at the end of a spindle which has no outboard support; these are more or less subject to vibration. Slotting or keyseat cutters are apt to develop a chatter in their work, due to the overhang from the spindle and also that the end of the cutter is unsupported.

Fig. 5 shows a piece of work *A* which is strapped down to the table by the clamps *D*. The cutter *C* is milling a wide slot through the piece at *B* and in its operation a chatter is developed. In this case the trouble is undoubtedly the work itself, as the cut which is being taken is heavy and the portion on which it is being made has a certain amount of spring, so that it pushes away from the cutter and then springs back again spas-

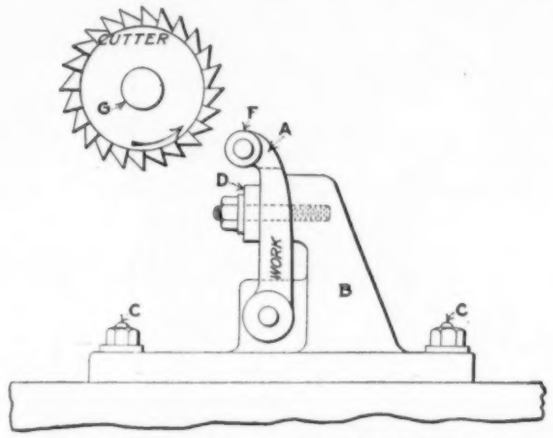


FIG. 6. POORLY CONSTRUCTED MILLING FIXTURE

modically. If the work were properly supported in opposition to the cutter the chatter would undoubtedly cease.

In fluting reamers or other tools of a similar nature, when they are of high-speed steel, chatter marks are often apparent in the flutes. An examination of the flutes of a reamer on which these marks appear will show that there are bright and dark spots on the flutes, indicating that the tool tends to glaze to a certain extent while making the cut. Sometimes a slightly slower speed and a little more feed will put an end to the trouble. At other times a lubricant such as a good lard or mineral-lard oil may be found which will assist in preventing the chatter.

It should always be assumed that the cutter is sufficiently sharp to do the work, particularly in the case of machining high-speed steel, because a dull cutter will give results which are extremely unsatisfactory.

Probably lack of support, or backing, for the work in opposition to the cutters is the most frequent cause of chatter in milling-machine work. An example of a fixture in which the work is held in such a way that it is not properly supported is shown in Fig. 6. The steel forging *A* is being straddle-milled at *F*, and the work is held on a fixture *B*, which is clamped to the table in the usual manner by the bolts *C*. The piece is clamped against the fixture by the strap at *D*. The cutters *G* travel in the direction indicated by the arrow and face both sides of the forging and cut between the two sides. In this instance insufficient support directly opposite the cutter was the cause and it could have been easily remedied by additional support at the proper point.

Although chatter is much less frequent in drilled work than in some other kinds it is still found at times. As a matter of fact, the majority of drilled holes go through the work entirely, so that a chatter at the point of the drill would not be apparent. Occasionally a drill does not seem to be "taking hold" in the way that it should,

and it may be removed from the work and ground or possibly stoned a trifle in order to make it cut better. After placing it again in position there will still be the feeling that it is not working properly. A certain amount of chatter at the point of the drill is sometimes the cause of trouble like this, especially if the drill is very long, as in the case of the drill *B*, shown in Fig. 7, en-

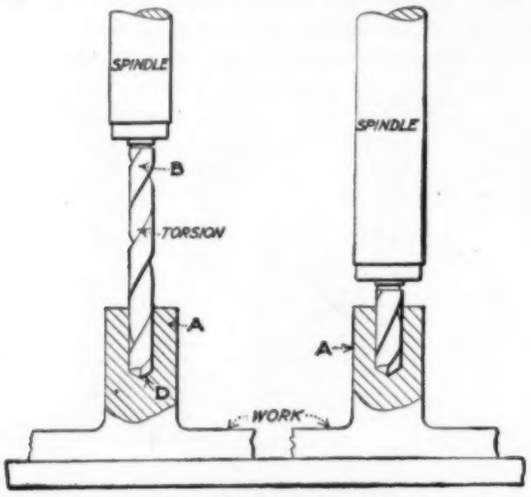


FIG. 7. DRILL TORSION IN DEEP HOLES CAUSING CHATTER

gaged in drilling the hole in the piece of work *A*. In this case it is the length of the drill and the consequent torsion that causes the chatter at the point *D*. It is difficult to suggest a practical remedy for such a case, as it is acknowledged that a chatter which has started on a piece of work will likely persist until the cut is finished. If a short drill is used for starting the hole there will be less torsion in it, and the chatter will not be so apt to start and will give a cleaner cut when the longer drill is put into the hole to complete the work.

Chatter in Turret-Lathe Work

Work that is being done on the turret lathe is usually produced in large quantities, and for that reason it is quite important that the cutting tools be as efficient as possible. Any trend toward chatter is injurious to the tools and the work and should be avoided. Fig. 8 at *X* shows a piece of work *A* which is chucked in the regular manner in a set of jaws *B* while the tapered hole is being machined. The reamer shown is of the floating type held in the holder *D* and pivoted at *E*.

As a reaming job of this kind would naturally be done by the hand of the operator (that is to say, no machine feed being used) much depends upon the workman's care and experience in securing satisfactory results. If the operator in reaming the hole allows the reamer to enter and be guided by the hole until he reaches the point where the entire reamer takes hold, a chatter will likely occur. However, if he is a careful man he will either stop his machine and enter the reamer by hand until he has reached a point where it starts to take hold, and then start the machine, or he will enter the reamer by hand very carefully with his machine slowed down to about one-third of the regular cutting speed.

Much depends upon the design of the reamer itself and the angle of the taper. If the taper is very shallow, that is to say if the angle is very acute with the center line of the reamer, it may be necessary to make the tool with a left-hand spiral in order to offset the tendency to "draw in," or a variation in the tooth spacing may be of help. In the case of a very shallow taper where the reamer has not been properly designed, great care must be exercised in reaming a hole of this kind. A reamer piloted at the forward end and hung loosely on the turret is less likely to chatter than one which is unsupported.

The speed at which the work is revolving seems to have a great deal to do with the chatter on a piece of tapered work like that shown, and by an adjustment of the speed to suit the conditions very frequently a chatter can be completely eliminated. The operator's judgment is also a valuable factor in a piece of work like this, because the amount of pressure with which he forces the reamer "home" into the taper has considerable

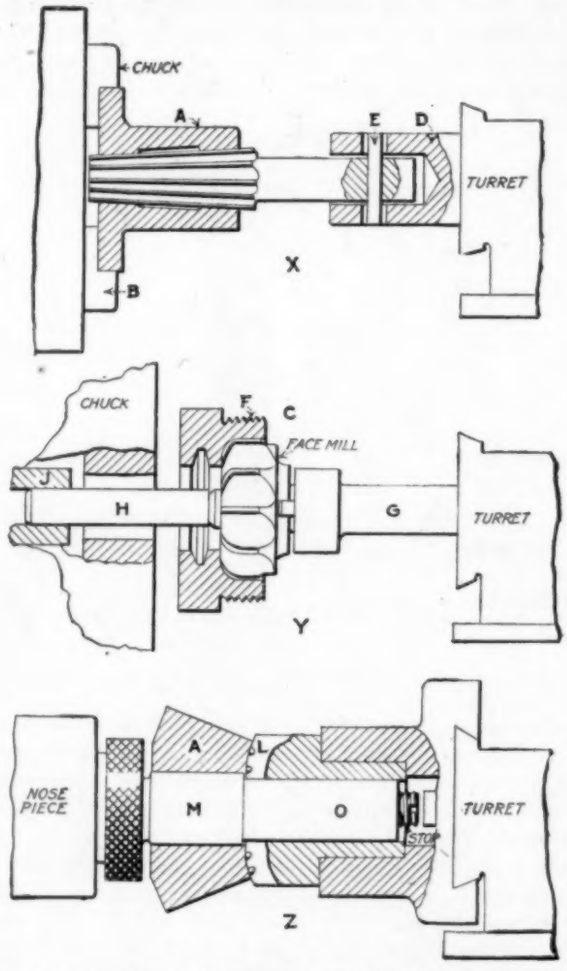


FIG. 8. VARIOUS FEATURES OF MILLING OPERATIONS

effect on the chatter. A firm pressure with sufficient force behind it to enable the reamer to take hold in good shape is much less likely to produce a chatter than a half-hearted effort.

When face mills are used in turret-lathe work they not infrequently produce a certain amount of chatter in their cutting action. Take the case shown at *Y*, Fig. 8, for example. The work *F* in this instance is a ball race which is to be finished by the face mill shown. This mill is secured to the arbor *G* held in the turret, and the forward end is piloted at *H* in the bushing *J* of the chuck. In this particular case the outside diameter of

the mill was about 3½ in. and the radius $\frac{1}{16}$ in. In attempting to finish the bearing *C* considerable chatter was found at the point where the radius portion of the tool took hold of the work, and the operator further asserted that the tools did not seem to take hold in good shape. There were 12 teeth in the face mill, and for this reason a considerable amount of cutting surface was presented to the work, so the pressure required on the tool was very great. To remedy this trouble half of the teeth were ground away, so that less surface was

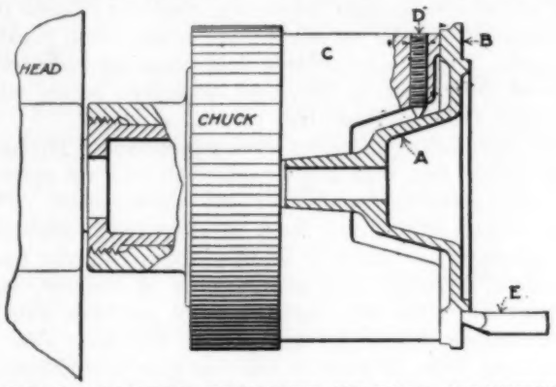


FIG. 9. CHATTER PRODUCED BY POOR CHUCKING

presented to the work, and as a consequence the cutting action was much easier than before, because more pressure on each tooth made it take a larger chip; glazing action was thus eliminated and no more trouble was experienced.

A similar example is shown at *Z*, Fig. 8, where the work *A* is a bevel pinion held on an arbor *M* fixed in the turret-lathe spindle. The cutting of the angular faces shown in contact with the face mill *L* caused much trouble due to chattering and because the tool did not seem to take hold, thus glazing over on the work. It will be seen that the face mill was of the hollow type and piloted on the end of the arbor *O*, so that at first glance it would not be evident where a chatter might occur. The face mill was of the four-lip type, and these four lips presented considerable surface to the work

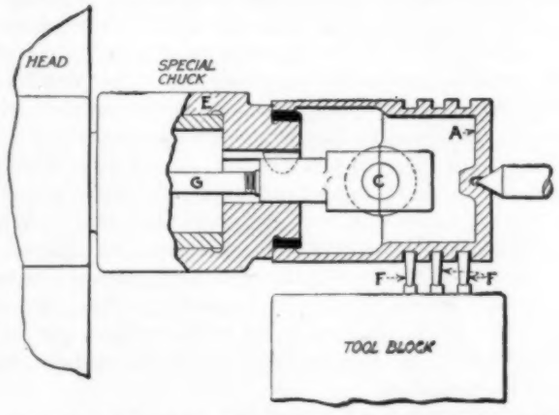


FIG. 10. CHATTER PREVENTION WHEN GROOVING PISTONS

during their cutting action. In order to make the cutting easier a couple of grooves, or nicks, were cut staggered in every tooth of the mill so as to break the chip. After this had been done the chatter was completely eliminated.

Frequently chatter in turret-lathe work is due to excessive overhang from the spindle in a piece of heavy work and its holding device, as shown in Fig. 9. The work *A* is held by the outside in a set of jaws *C*, having an additional support in the setscrew at *D*. The necessary operations were performed with the tool *E* on a lathe of the flat-turret variety. During the process of facing the flange at *B* a great deal of chatter was apparent. Thinking that it might be in the tool itself, this was held considerably shorter, so that there was less overhang at this point; but this did not materially help. Various gibs were then tightened and the spindle caps taken up and all end play taken out of the spindle without result.

Finally it was suggested that the trouble might be due to the overhang of the heavy piece from the spindle. As there was only a small number of pieces to be machined it was not deemed expedient to substitute a new set of jaws or another method of holding, so a unique

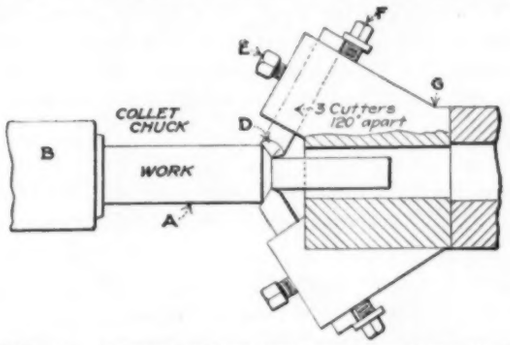


FIG. 11. ROUGH WORK DURING A HEAVY CUT

remedy was adopted. The tool was placed on the other side of the turret, so that the cutting action pulled up instead of down upon it (the tool being reversed and blocked up sufficiently to bring the cutting edge in proper relation to the work). By this arrangement the spring caused by overhang was largely overcome and chatter prevented.

It is important in gas-engine piston work to so machine the grooves in which the rings are set that they will be within the required accuracy. There are usually three or more of these grooves, and they are machined simultaneously, so care must be taken to insure precision. Fig. 10 shows a piston *A* held on a special nosepiece *E* which is screwed to the end of the spindle. A pin *C* is drawn back to hold the piston in position by means of a rod *G* which extends entirely through the spindle. The tools *F* are held in a special block which is mounted on the cross-slide of the turret lathe. Cutting these grooves without some sort of support for the work will not be satisfactory on account of the chatter caused by the overhang and the severe cutting action of the three or more grooving tools.

Several remedies for this condition can be used: The work may be supported by means of roller back rests attached to the turning tool or to some other convenient support; or a center support may be used by adding enough stock to the end of the piston to permit centering. The feeds for work of this kind must be very light, and further it is important that the tools are keen and that they are set a little above center.

A few years ago the writer observed a peculiar instance of chatter. Some bar stock of 2-in. diameter was to be reduced to 1 in. for a distance of 12 in. along the

bar. The cut was a roughing cut only, and great accuracy was not important. As illustrated in Fig. 11 the bar *A* was held in a collet *B* and the work was done on a horizontal turret lathe. A special cutter head, or hollow mill as it might be called, was made in order to hasten the work. This cutter head *G* was fastened to the face of the turret, and equidistantly around it were three cutters *D* which were backed up by the screws *F* and held in position by other screws *E*. The tools were ground at the forward or cutting end so as to assist in centering the work. The feed was 0.040 and the time consumed was 1 min. 12 sec. The torsion on the bar under the heavy cutting action of the three tools produced an almost perfect spiral chatter on the outside of the work, the marks being so apparent that the experiment was considered impractical and subsequently it was abandoned.

The remedies for the examples here given can be applied to other similar work in machine shops, but in seeking a remedy for chattering it should be remembered that the hit-or-miss method is not reliable, the best way being to analyze the conditions and then apply the remedy.

Economy In the Small-Arms Section

By Paul Allen MacKenzie

In connection with a previous article that appeared in the *American Machinist* on the cost-plus contract it is interesting at this time to follow it up with the results of a report made a few weeks ago by the Procurement Division of the Ordnance Department to the Secretary of War, which showed that a saving of $8,750,000 had been made by means of salvage, utilization or sale of discarded material and waste prevention in the last two calendar months alone, in the Small-Arms Section of the Procurement Division.

Col. Samuel McRobert's report on the action of this section of the Procurement Division to Gen. C. C. Williams, the acting Chief of Ordnance, shows the economies subdivided as follows: On small arms, $1,395,398.52; on machine guns, $6,165,218.22; on small-arms ammunition, $1,196,408.85; total saving for the two months, $8,757,025.59.

This saving was effected in different ways. The manufacturing processes of small parts for rifles, machine guns and revolvers have been in a continual process of evolution, making unnecessary many operations and thus cheapening the cost of production. The saving on rifles alone amounted to $43,000 in two months.

Encouraging Bidding

There has been much criticism from time to time of the Ordnance Department for not increasing its field of production by notifying more bidders to figure on the Government's requirements. Approximately $528,000 has been saved in the past two months by obtaining new bidders not heretofore participating in competition for contracts on appendages and accessories of small arms. This is conclusive proof that the Ordnance Department is not withholding business from the small, deserving manufacturers throughout the country who desire to work for the Government.

Coöperation with the War Industries Board in purchases brought a further saving of $40,000, and revision of the requirements for spare parts on pistols and rifles enabled the small-arms branch to save an additional $522,862. The saving on arms, repair chests and accessories amounted to $262,570.94.

An example of the economies effected in producing small arms is the elimination of the waxing and buffing of gunstocks and the substitution of an oil finish, which saves $17.50 per thousand on rifles and is a far superior finish for service in the field.

Many small items, in themselves inexpensive but the cost of which is high when the quantity which the Government is ordering is considered, have been greatly reduced. As an illustration, field cleaning rods were reduced from 49c. to 35c., and smokeless barrel steel has been reduced from 12c. to 10c. a pound.

The negotiating officers of the Procurement Division have proved that they are on their job and are getting the best possible results for the Government. The machine-gun branch has kept in close touch with the manufacturers in order to be in position to insist upon reduction in prices whenever tooling-up charges, etc., have been written off. As a result it has been able to show a greater rate of saving, and has been able to reduce the price of Vickers machine guns $322.35 each, Colt machine guns $284.16 each and Lewis machine guns $22 each. The machine-gun branch reports that it applies the same principle to the various machine-gun accessories.

The ammunition branch did not have as great an opportunity for saving. The production of ammunition had reached such a state of perfection prior to the war that it was improbable that the branch would show much improvement over the prices secured. For this reason the branch made most of its savings on clips and bandoleers, although it was able to save on the 30-caliber rifle ammunition and 45-caliber automatic-pistol ball cartridges, etc.

Checking Costs

The cost of tools, dies, master dies, etc., for rifles is checked very carefully in every factory, as their cost runs into enormous figures. All material purchased for manufacture must be approved before the contract is placed, and the price paid cannot exceed that accepted by the War Industries Board and agreed to by the steel manufacturers and approved by the President. Labor cost is carefully checked and manufacturing methods inspected by Government representatives.

The result has been that the Government has reduced the price of rifles compared with their price at the beginning of the war by about $13 each. When the placing of rifle contracts was first considered at the beginning of the war the rifle companies considered $35 to $40 a fair price. At present the Government's rifles cost about $22 each to manufacture, and it is probable that in the future this price will be even further reduced.

The Ordnance Department has been the recipient of much unjust criticism in the past, which was largely caused through the misunderstanding of the general public, which is naturally ignorant of the almost insurmountable barriers that the negotiating officers had to contend with, and it is believed that this report will help to clear away much doubt and misrepresentation and give the Ordnance officers the credit which they justly deserve.

SIDELIGHTS

EDITED BY E. C. PORTER

The Pennsylvania Railroad has notified 50 former employees retired on old-age pensions that places will be made for them if they will return to work, and that their standing as pensioners will not be prejudiced by such action.

* * *

Employment of crippled men is reported by the Electric Power Companies at Cavendish, Vt., and Claremont, N. H. A one-armed man serves as a load dispatcher and a lame man is found to be efficient as a power-house operator.

* * *

Locomotives ordered during June numbered 390, all for domestic use, compared with 360 ordered for domestic use in June of last year. In the first six months of the year locomotives to the number of 1782 have been ordered for domestic use, while during the same period last year 2241 locomotives were ordered for the same purpose. No cars were ordered during June.

* * *

The Remount Division of the War Department has purchased since Apr. 6, 1917, 366,392 horses and mules for the army. Since the United States entered the war the motor-transport service has bought 27,005 motorcycles and 25,874 side cars for motorcycles. A total of 9809 motor ambulances have been purchased. On July 1, 1918, reports showed 18,098 American motor trucks and 3420 passenger automobiles in France.

* * *

Business failures in June numbered 776 compared with 836 the month before and 1113 a year ago. Liabilities of the failed concerns were $9,000,000, compared with $11,000,000 a month ago and $15,000,000 dollars a year ago. During recent weeks failures have been fewer than at any time during the past 10 years, which is evident that the sales of Liberty Loan bonds have not interfered with the proper financing of business.

* * *

The United States Shipping Board Emergency Fleet Corporation announces that 26 steel cargo vessels and 10 tugboats were contracted for during the week ending July 27. Included in the contracts were the four 10,000-ton steel cargo vessels to be built in China by the Kiangnan Dock and Engineering Works, Shanghai, China. The other contracts were placed as follows: Eight 8800-ton steel cargo vessels; fourteen 8800-ton steel cargo vessels; six steel tugs, ocean-going, and four wooden tugs.

* * *

About one million Liberty bonds of the first, second and third issues have been registered by the Treasury agents against loss by theft, and Secretary McAdoo has adopted a definite policy of encouraging owners to have their bonds registered, which can be done without cost. Applications for registration and full information may be obtained at most banks. A plan by which subscribers can register their bonds by filling out an information coupon may be developed for the fourth loan.

The shortage of agricultural implements in Scotland, due to trade restrictions and transportation difficulties, is indicated by the extraordinary prices realized at a sale held recently near Edinburgh when the farm machines, etc., used by the East of Scotland College of Agriculture were offered at auction. Binders, mowers and reapers sold for 50 to 75 per cent. more than the price originally paid. A hayrake which cost £10 ($48.66) when new brought £21 10s. ($104.63); a fanner, costing £9 ($43.80), sold for £24 ($116.80), while a drill, which had been purchased for £18 ($87.60), realized £38 10s. ($187.36). Farm carts sold for £21 ($102.20) to £23 ($111.92).

* * *

American shipyards launched 15 vessels during the week ending July 25. The steel yards put into the water 10 vessels, totaling 53,250 deadweight tons; the wood yards, five vessels, totaling 19,200 deadweight tons. The Pacific Coast yards led with seven launchings. The Great Lakes yards were second with six. There was one each on the Eastern and Gulf coasts. The launchings for the week included another 4700-ton wood ship from the ways of the National Shipbuilding Co. of Texas. The week's output of completed ships was eight of 35,890 deadweight tons. Great Lakes shipyards led the deliveries with four vessels. The Pacific Coast was second with three. The single Eastern delivery was of a 7400-ton freighter from the Bethlehem Shipbuilding Corporation at Sparrows Point, Md. This was also the largest ship completed during the week. The number of vessels built for the Shipping Board is nearly 250, totaling more than a million and a half tons.

* * *

American records for daily production of ammunition for rifles and pistols were broken on June 27, when approximately 27,000,000 cartridges of every description were produced in plants manufacturing for the United States Government. This figure includes no cartridges manufactured commercially or for other Governments. The twenty-seven million should not be regarded as an average production figure—only as high record. The daily average for the production of United States Army rifles of the models of 1917 and 1903 was broken in the week ending June 29. An average of 10,142 rifles of these types—the modified Enfield and the Springfield—was maintained, 55,794 rifles being produced, together with spare parts, equivalent to several thousand rifles. Russian rifles to the number of 3280 also were manufactured. Mr. Cahill, a workman in the rifle department of the Midvale Steel and Ordnance Co. at Eddystone, Penn., finally assembled 281 Model 1917 rifles in a 10-hour day recently. This is a record. The average finally assembled per man is approximately 200 a day. When Eddystone was making rifles for the British the largest number assembled per man a day was 50, and the average was 40. Mr. Cahill's only comment on his record was, "I guess the boys in the trenches will need them."

The Foreman to the Slacker

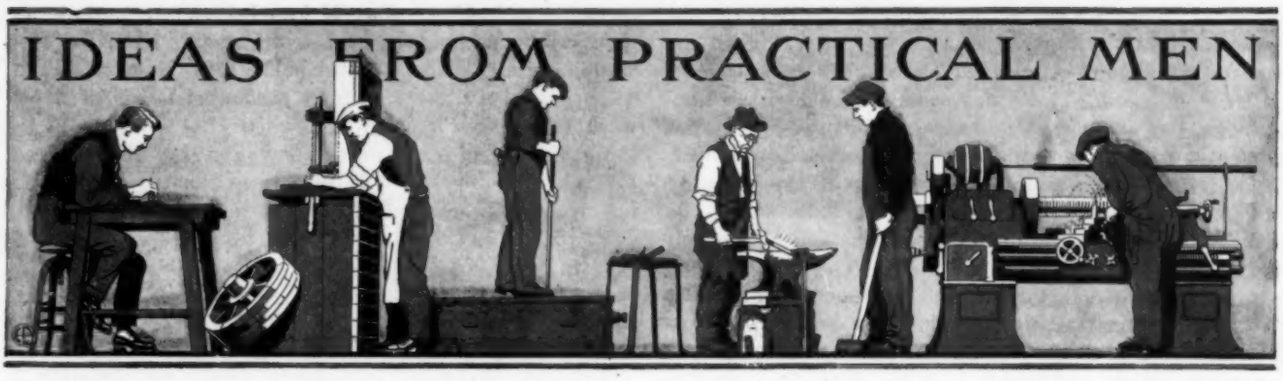
BY BERTON BRALEY

Well, I see you're back on the job again
After loafin' a week or so,
An' killin' a dozen of soldier-men
Who battle against the foe!
You ain't killed no one? Oh yes, you have!
I'm puttin' it to you straight,
This ain't no buncumbe, or bull, or salve,
But a fact that is sure as fate.

The tools that we make in this factory
Are tools that are needed for
The work of fittin' the ship for sea
An' makin' the guns for war.
If there ain't plenty of ships an' guns,
Our boys who are over there
Will face the line of the bloody Huns
With never a chance that's fair.

You took a layoff? Well, look ahead
An' think if it isn't true
That there'll be several good men dead
An' simply because of you!
They'll lack for things that you didn't make
When loafin' around at ease,
An' so, while fightin' for freedom's sake,
They'll perish there, overseas.

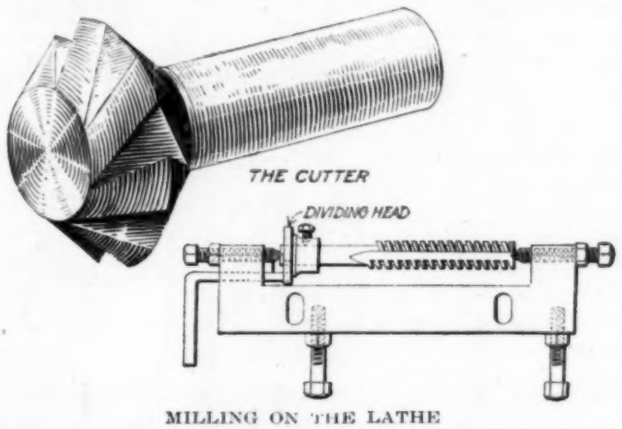
You never thought? Well, you ponder now,
An' I reckon you'll see more clear
The way things stand, an' you'll grasp just how
You're part of the army here!
If you'll help to see that the ranks are filled
It's possible by and by
You'll save them fellers I said you killed,
So speed up the work—an' try!



Fluting a Tap Without a Milling Machine

By N. S. Welk

The writer having a number of taps to make and no milling machine to flute them made the device shown in the illustration. By bolting this to the side of the lathe cross-slide the work was done as nicely



MILLING ON THE LATHE

as with a milling machine. The cutter was made to fit a standard spring collet, and the indexing device bolted to the slide by using the holes provided for the follow rest. The construction is clearly shown in the illustration.

Effect of Imperfect Centers on Cylindrical Ground Work

By Robert J. Spence

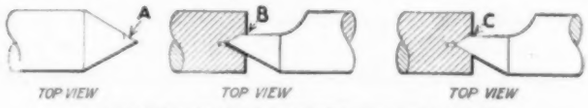
On all universal-grinding machines there is a screw for adjusting the swiveling table so as to obtain the proper setting of the work. It is a deplorable fact that many operators ignore the functions of this screw and hit the end of the table with a bar of steel or other heavy piece of metal to get the proper alignment of the work.

It requires little practice to attain the knack of proper setting by means of this screw, and the results are more satisfactory. If pounding the table is resorted to an abnormal strain is set up against the screw, which is liable to be released at any time, making necessary a repetition of the pounding.

Aside from defacing the machine there are other points to consider. The time lost in pounding is greater than would be required for proper setting in the first place; further, a mechanic is judged by his actions, and abuse of a machine in this manner does not add to his reputation for ability.

All modern cylindrical grinding machines have a large, hardened pivot and the hole in the table is scraped to a close bearing on this pivot. If there should be movement between the pivot and its bearing a change of alignment of the table might occur under wheel pressure. However, in a machine built by a reliable manufacturer this error is not likely to be encountered, as such a small amount of wear takes place at this point that there is little contingency of trouble from this cause.

The reason of a change of alignment can almost invariably be traced to the center points of the machine or



EXAMPLES OF IMPERFECT CENTERS

the center holes of the work. The pressure of the grinding wheel against the work is always in one direction and the center points naturally wear away more on the side toward the wheel, as is shown at *A*.

When a center point reaches this condition and a piece of work having a center hole deeper than the hole in the preceding piece is put into the machine the alignment of the axis of the work is changed. The piece then grinds smaller in diameter at the end toward the deeper center hole, the work being moved nearer to the grinding wheel at this end. Many operators will unhesitatingly assume that the swivel table has changed and will endeavor to correct the error without suspecting its real cause.

It is a good practice to have ready a number of extra reground center points so that a change can be quickly made as soon as wear becomes noticeable. Wear can be detected more readily on the work than by the appearance of the center point, as a wear of 0.0005 in. is not apparent to the eye, whereas the resulting error in the work is quite perceptible when measured with the micrometer.

A piece of grit or dirt of any kind between the tapered shank of the center point and its socket will allow the center point to shift under different wheel pressures. This often gives rise to the belief that the swiveling table is changing its alignment, and the resultant lack of confidence in the stability of the machine is followed by continued whacks on the table with a heavy piece of metal. Care should be taken before placing a center point into its socket to see that it is

perfectly clean. All projecting lumps should be carefully removed from the tapered surface to insure a good fit. The socket should be cleaned thoroughly each time a center is changed. These may seem like elementary suggestions, but experience and observation teach that the elementary things are the ones most often overlooked, and this difficulty is one hard to locate if the operator has no previous clue to its source.

Sometimes the operator becomes very much annoyed by the work measuring out of round. The cause of this is so closely allied to the trouble just mentioned that it is worth calling it to his attention, for despite the care that is used a piece may be anything but round and the cause apparently unsolvable.

A piece of work is shown at *B* with the edge of the center hole dented in handling. While in the position shown the dent holds the side of the center hole away from the center point and the work turns for a portion of its revolution upon a false bearing. As soon as the piece turns around to the portion of the center point that is cut away as at *B* the work momentarily revolves on its true center, this oscillation back and forth causing the work to be ground out of true.

A center hole that is not absolutely round will give a poor result in the finished product as will also a piece of dirt or scale in the center hole. For this reason it is advisable, where accuracy is essential, to add the operation of recentering, or lapping, if the work be hardened.

The work should not be stood on end either on the floor or on the bench while fastening on the dog, as some foreign substance is likely to get into the center hole and cause trouble; rather is it preferable to fasten on the dog with the work either in a horizontal position or at an acute angle.

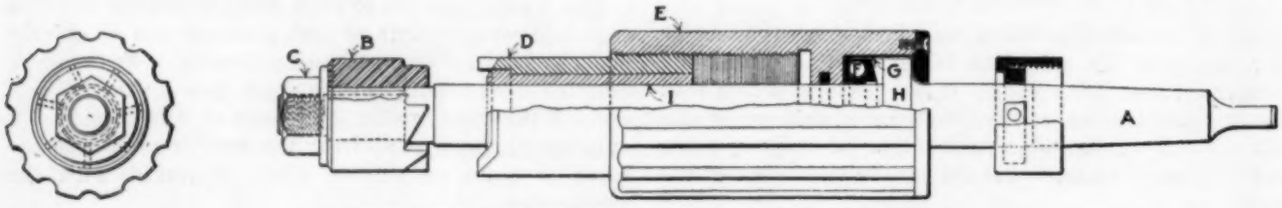
The quality of the work produced by a grinding machine depends so much on the condition of the center points of the machine and the center holes of the work that they should receive as careful consideration as any part of the machine. A grinding machine is no more accurate than its center points.

Back Facing Tool

By G. E. Baldwin

The figure shows the assembly of a back facing tool used in a drilling machine. This is built on the arbor *A* with a Morse taper shank. The cutter is the part *B* keyed to the arbor, and after passing the arbor through the work the cutter is placed on the end and held by the nut *C*.

On the opposite side of the piece being faced is the thrust collar *D* which presses down on this side of the work to put the necessary pressure on the cutting edges of the tool. The amount of pressure and feed given is applied and regulated by means of the internally threaded adjusting collar *E* knurled on the outside so that it may be gripped by the workman's hand for setting down. The thrust of the collar *E* is taken up by the set of ball bearings *F*, which through the set of bevel washers *G* have a bearing against the shoulder *H* on the arbor. The other parts shown are details required for the assembly. It will be noticed that the part *D* is bushed with a sleeve *I* of bearing bronze.

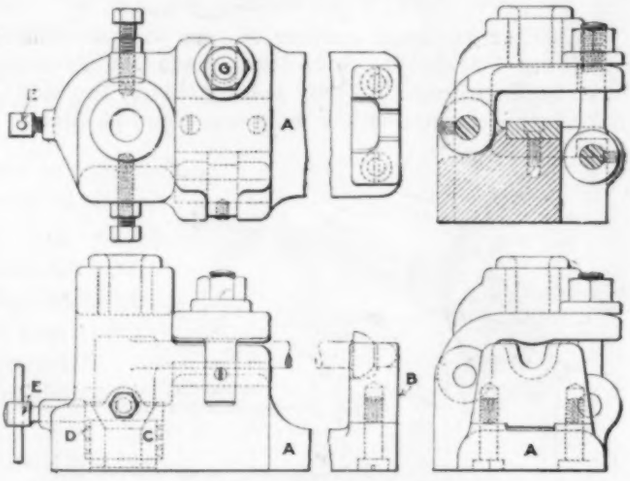


BACK FACING TOOL TO BE USED IN A DRILLING MACHINE

Drilling Jig for Machining a Light Cast-Iron Lever

By Christian F. Meyer

The jig shown in the sketch was made to drill a ⅜-in. hole through the boss of a lever, the shape of which is clearly indicated. The long shank is very thin, and it frequently happened that it would bend and cause the hole to be drilled out of square with the center line. The jig consists of a cast-iron base *A*, at one end of which is fastened the steel supporting block *B*. This block is fitted to receive the round head of the lever. The other end rests upon a hardened-steel plate, the boss extending beyond it and resting upon the bushing *C*, the latter being supported by a spring *D*. As the bushing has a cone-shaped opening on top it will automatically center the boss. It may be securely held in any position by the screw *E*.



JIG FOR DRILLING LEVER

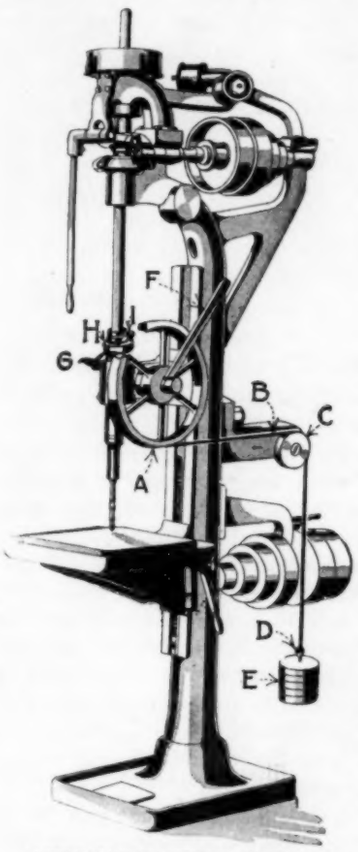
In operation the lever is inserted in the jig, the boss entering the cone-shaped recess in the bushing *C*, pressing the latter down against the action of the spring. As soon as the lever is clamped down the bushing is secured in position by the screw *E*, thus providing a support against the pressure of the drill.

The jig gives excellent results, and the principle involved in its construction may be found useful for similar problems.

Automatic Feed Attachment for Drilling Machines

By R. E. Byrd

Numbers of the lighter types of gang drilling machines are not equipped with an automatic feed device and so must be fed by hand. There are cases where several single-spindle machines are located in proximity so that one man can place the work under several machines in succession before the drill has finished the work on the first when means are provided for other than hand feed on the spindle. A method of accomplishing this is by applying weights to provide pressure on the spindle, the amount of weight depending on the size of the drill. The illustration depicts the way this was done. On the short shaft that carries the spindle feed pinion is placed the wheel *A*, with a concave face, on which is wound a light, flexible-steel cable *B*. This cable extends to the back of the machine over the idler pulley *C* and terminates in a small forged hook *D* on which the requisite weights *E* can be carried. When refilling the chuck beneath, the spindle is raised by the handle *F* attached to the cable wheel until the latch *G* can be snapped below the collar *H* that surrounds the spindle. The spindle remains in the raised position until the latch is released, immediately the drill begins to feed into the work to the limit of travel provided by the collar, and is also controlled by the stop screw *I* on the back of the collar. On the lower portion of the stop screw is a spring which comes into play just as the drill begins to pass through the work; this prevents its breakage.



AUTOMATIC FEED FOR A DRILLING MACHINE

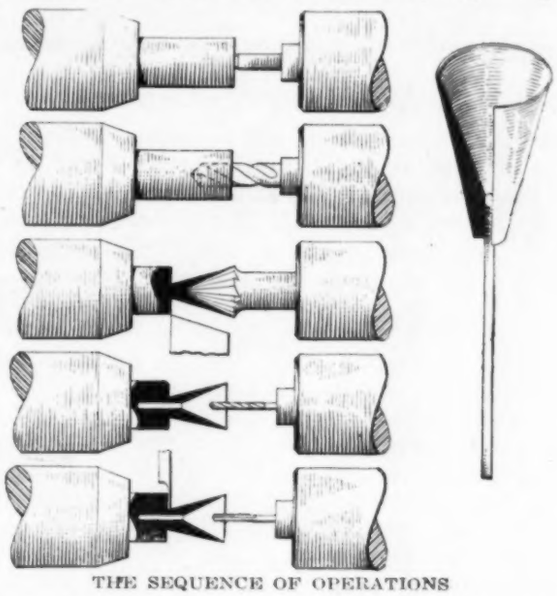
In order to avoid shutting down the machine to change drills when these become worn and dull Magic chucks made by the Modern Tool Co. are employed, and the operator changes drills without stopping. The worn drills are turned over to other workmen for regrinding.

Making Oil Cups on the Automatic

By H. Maplethorpe

The sketch shows a set-up of the Cleveland automatic for turning out what is known as the "lilly" oil cup which is used in large quantities in connection with sight-feed lubrication of high-speed engines. The work had been chiefly produced by hand, and the job was regarded as a nuisance and one which nobody wanted, as it was difficult to hold and most of the metal was removed with hand tools.

The positions are shown in sequence, beginning at the top, and hardly require explanation. The time for each cup is 1½ minutes. At the right is the completed cup screwed onto a brass oil pipe.

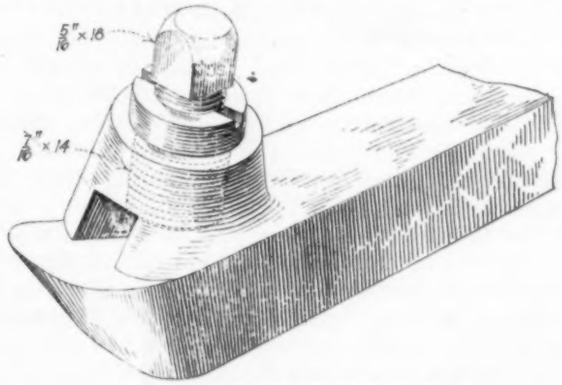


THE SEQUENCE OF OPERATIONS

Repairing a Toolholder

By J. H. Davis

The sketch shown described how a toolholder was repaired, the thread of which had been stripped. When it came into my possession it was tapped $\frac{5}{16}$ x 20 minus a screw. A screw was made and it did continuous work for two and one-half years. The thread then stripped in the toolholder and it was tapped $\frac{3}{8}$ x 16



THE REPAIRED TOOLHOLDER

A new screw was fitted and it was all right for three months, when it was lent to a night man, who stripped the thread on the second night. I then tapped it $\frac{7}{16}$ x 14 and fitted the screwed bushing, as shown. This bushing was slotted at the top and drilled and tapped to receive a $\frac{5}{16}$ x 18 screw. If the screw thread strips now I have only to fit a new bushing. The bushing is made of machine steel but no doubt tool steel would be better. The screw might also be made of tool steel.

Editorials

An Announcement

Readers of this journal will be pleased to learn that John H. Van Deventer, until recently major in the Ordnance Department, has resumed his duties as editor of the *American Machinist*. His return is an evidence of the importance which the Government attaches to the war service which this journal is rendering, for his release was asked for solely on the ground that he could render a greater service to the Government through the editorial chair than by personal service in Washington or with the forces.

It was our feeling when Major Van Deventer's services were requested by the Government last September that he could best serve in his editorial capacity. Investigation, however, disclosing that there were certain problems for solution, in which he had special experience, a leave of absence was gladly granted him, the suggestion being made at the same time that he be released from the military organization after these problems had been solved.

Major Van Deventer's first work in Washington was with the Gun Division. A survey of the situation showing that personnel was the all important problem, his earliest work included the institution of a campaign through which machinery builders within two weeks furnished to the Government 200 of their best draftsmen. Following closely on this, he initiated the organization of business men for the purpose of obtaining a supply of stenographers and other civilian employees. So effective was this organization that it was taken over bodily by the Civilian Personnel Division when the division was established some time later.

While in the Gun Division, Major Van Deventer formulated, installed and managed the system of control for the drafting and design section; organized and managed the Coördination Branch, established to coordinate the work of the Design, Procurement, Production and Inspection Sections of the Gun Division; and organized a Military Information Branch, which later became the Military Information Section.

When the Ordnance Department as a whole was reorganized on functional lines in January of this year, Major Van Deventer was called upon to assist in developing a suitable organization for the Engineering Division. He initiated, developed and installed many of the methods by which the technical work of the division is coördinated and controlled. These methods enable the technical routine of the largest engineering organization in the United States to proceed with surprising smoothness.

Perhaps the most valuable service which he has rendered the Government has come through his connection with the machinery building industry. Through it he has been instrumental in securing for the Ordnance Department the services as commissioned officers of many men eminently qualified to handle the difficult specialized problems arising daily.

We are gratified at the evidence of official recognition by the War Department of the value of the *American Machinist* to our war industries, when at our request, Major Van Deventer is released so that he may make this journal of even greater service than it has been, in interpreting the problems of the Ordnance Department to the thousands of machine shops of this country.

Fred H. Colvin, who has so ably conducted the editorial department during the past year, and who has made thousands of friends in all parts of the mechanical world, will, as Principal Associate Editor, continue to do his share in making the *American Machinist* an invaluable aid to American war industry.

THE PUBLISHERS.

Training Women for the Shop

WOMEN in machine shops are no longer a novelty, and we are becoming accustomed to seeing them at all ages, from 16 to 60, dressed in overalls of blue or of khaki, handling work on machines of various kinds. But we must not forget that few of them have had any previous shop training and that very few indeed have any marked mechanical tendencies. There are exceptions, of course, just as there are occasional men milliners and dressmakers, but the average woman is not mechanically inclined any more than the average man takes kindly to making tatting or embroidering handkerchiefs. This may change in the course of a few generations, but for the present we are confronted with the proposition of training women for our shops, and it is a real and serious problem.

We have proof on every side that they can be so trained, and we are finding more and more occupations which they can fill satisfactorily.

The first step is the proper selection of women for the different kinds of work, and this requires an employment manager who shall be of a very different type from those of the old days when any sort of clerk was considered good enough to do the hiring and firing. The work should in reality be done by a trained woman, and the day is coming when every plant employing women in any numbers must have a competent woman on its employment staff.

Next comes the training, and this must be done whether we have the proper employment force or not, though proper selection makes the training easier and adds materially to the actual production of any plant.

This training, like selection, requires skill and a special aptitude for the work. Carelessness or impatience can easily be made very costly in several ways. It requires much tact to both interest and instruct girls in an entirely new line of work so as to make them valuable producers and to hold them steadily on the work, and without some real interest in the work it is impossible to prevent a large labor turnover in these days when, it seems, there are two jobs open to every worker.

It seems to be generally conceded that in most cases the preliminary, or vestibule, training school has many advantages over the plan of putting new girls directly into the shop. This is particularly true where the girls work side by side with men in the shop, which is often the best plan. They are naturally somewhat timid about attempting to run a machine that is entirely new to them in the presence of men who they assume know all about it and who are watching for mistakes on their part

There is also the advantage of preventing a loss of production in the shop both by the actual time lost on the machine and also by the disturbance due to a new hand being mixed in with the other workers, particularly if it is a new proposition in the shop. A little preliminary training also tends to reduce the number of accidents.

The mere establishment of a training school, however, does not solve the problem. It is the way in which the workers are trained that counts, and this is such a new problem that we have much to learn in connection with it. The girls must be made familiar with the machines, which should of course be carefully guarded. Then they must be taught not to fear them as long as they are properly managed. Next comes the handling of the work, the placing of it in the machine, performing the cutting or other operation, and removing it, with, perhaps, an inspection or gaging as the case may be. Care should be taken to see that the operator understands what she does and why it is done, although some think this unnecessary. It is reasonable to suppose, however, that when anyone knows what is to be done, and why, one can work more intelligently as well as be more interested in one's work.

Some enthusiasists on the subject have told us many almost miraculous tales concerning the aptitude of women and the rapidity with which they can be taught to become producers. But while we all admit that wonderful results have been obtained in special cases we should remember that this is not the day of miracles and we will do well not to expect too much.

We must be patient and, above all, be fair in all dealings with the new unskilled labor of both sexes, which we are of necessity using in such large quantities and on whom we must depend for much of our future output. If we are patient and use good judgment both in picking the workers and also those who are to teach them, if we handle the situation with discretion, surprisingly good results may be obtained.

The Responsibility of All

THE need of constantly increasing the production of munitions of all kinds can hardly be over-emphasized, and strenuous efforts are being made to extend our manufacturing capacity along various lines. But manufacturing capacity means more than shops equipped with machinery of different kinds. It means men and women skilled in the operation of these machines, who stay on the job day after day. And skill is not enough; steady application is absolutely necessary to secure the munitions we must have. Every day lost means prolonging the war with its daily toll of life and treasure.

Complaints come from many quarters of the large percentage of absentees day after day. The high wages that prevail and the fact that men and women can get along without working full time seem to blind many workers to the great need of the steady work that is necessary in order to produce the various kinds of munition. A half-day lay-off seems little to the individual, but when multiplied by hundreds and thousands it soon totals up to months of one person's time or one machine's production.

Much effort is being devoted to overcome this loss of production, and posters, circulars, shop meetings with patriotic addresses are being used to show the workers the necessity for constant production. The shops of Rochester, with their usual community spirit, are having addresses by noted men and women during working hours at no expense or inconvenience to the workers.

There is even talk of disloyalty being behind the indifference to maintain production at its highest point. We do not however believe that this charge has any foundation except in isolated cases. The trouble lies in the failure of many to realize their personal responsibility; to see that their work is important.

The soldier knows exactly what his responsibilities are. If he is on sentry duty he knows that he guards the safety of others. But comparatively few in civil life appreciate the responsibility that devolves upon them in the shop. And in most cases it is the lack of appreciation of this responsibility that lies at the bottom of the seeming indifference.

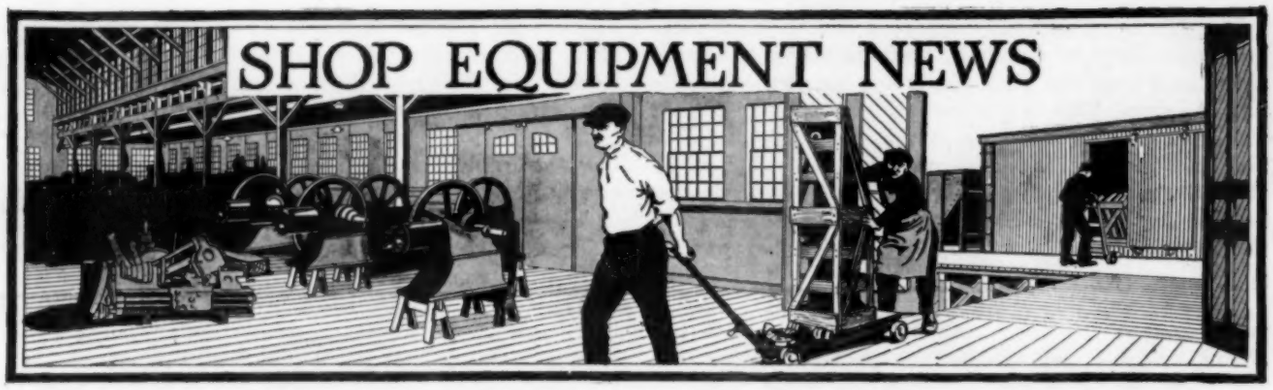
We must try by every means to make all understand that the safety of the future depends upon everyone doing his or her duty to the full. None of us is outside the pale, everyone of us counts. If we do not it is because we are not doing all that we might. If anyone feels that it does not matter what he does, let him get into something essential at once. We need the full power of every producer—every man must stay on the job till the war is won.

A Community of All Nations

WAR necessity is a tremendous power for rapid change. Overnight come reforms and improvements that in the old days meant decades of halting and debate. Do we clearly realize the full significance of these days?

Slow transportation and imperfect communication mean isolated communities. With improved facilities for intercourse came growing familiarity, understanding, respect. Intercommunication, conference and a common purpose are binding free nations closer than ever. Prejudices and misunderstandings are going into the discard. International barriers are being leveled, and war realities are proving the practicability and the advantage of close coöperation among the people. We are no longer an isolated nation; we are now citizens of the world! We shall not soon forget the Marne or the nations whose men fought beside ours. When future problems arise will not the nations view them in the light of the glorious vision of Americans, Canadians, Australians, British, Italians and French fighting shoulder to shoulder for freedom on the fields of France?

Canada and the United States show what the relations can be between people who intimately know each other. The exchange of ideals, of ideas and of commodities with our fellow men must henceforth be extended to all lands. For such makes a community of all nations.



Eccles & Smith Milling and Dividing Head for Lathes

The Eccles & Smith Co., 71 First St., San Francisco, Calif., is now manufacturing the milling and dividing head attachment for lathes shown in the illustration. Fig. 1 shows the milling attachment with overhead drive and dividing head and also the method of securing power longitudinal and cross feed with dead spindle, while Fig. 2 shows the grinding and spacing attachments in place on the bed of the lathe. The device is

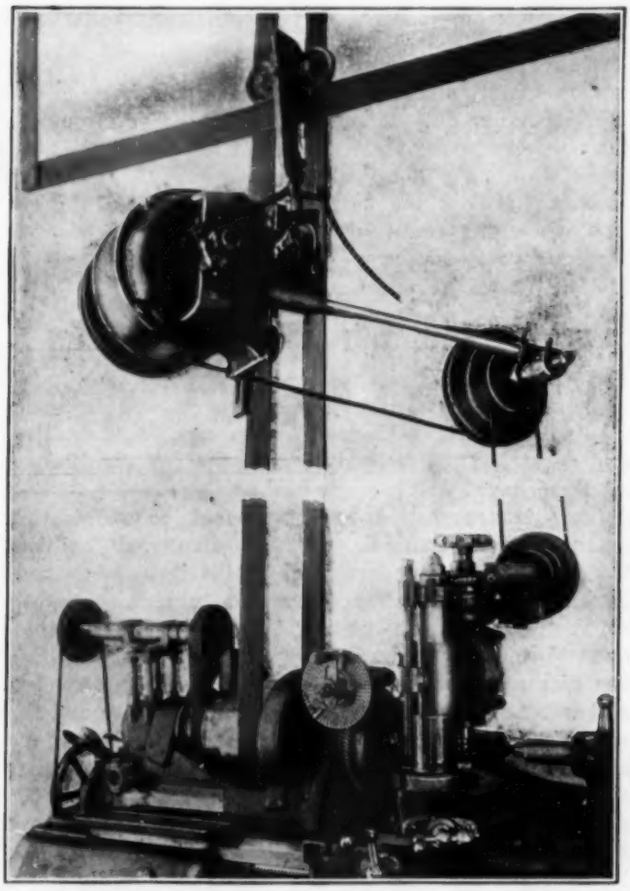


FIG. 1. THE MILLING AND DIVIDING HEAD

arranged with overhead motive power so that this is delivered to the tool in whatever position it may be. In doing dividing work, the work may be held either between centers or in a chuck. The milling device can be attached to the lathe without any fitting and in action is fed by the lead screw feed by means of a belt drive to the lead screw train from the smallest headstock cone. This construction is necessary on account of the fact that for some operations the center or chuck

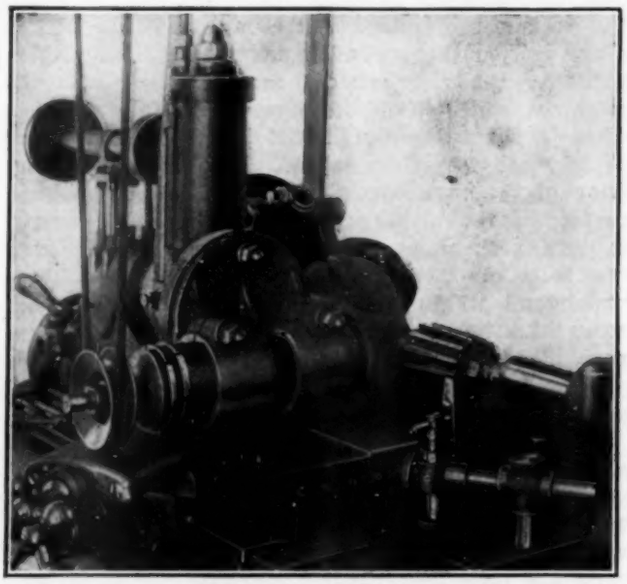


FIG. 2. THE GRINDING AND SPACING ATTACHMENT IN PLACE ON THE LATHE

is held stationary while the carriage moves. The indexing mechanism is geared 2 to 80 and uses standard dividing plates, the same as an ordinary milling machine. The gear is fitted over the sleeve of the chuck plate hub and change may be made from chuck to faceplates by standardizing the hub and using studs through the chuck plate with a round extension to fit corresponding holes drilled in the web of the worm gear. The worm dividing mechanism is supported by means of a yoke and spindle, a shank fitting into a trunnion, this being supported by bearings fixed to the front journal box. The mechanism has the necessary changes of radius to reach through the proper length of arc to mesh through the work gear, no matter how far it may be from the spindle of the lathe. It is locked in position by tightening bolts on the ends of the trunnion bearing and a split sleeve holding the work-carrying spindle. It is possible to turn work on faceplates or between centers and divide and calibrate it without disturbance of the original setting in the machine. A high-speed head for wood turning, or pattern work, is furnished, which is screwed on the lathe nose, this deriving its power from an independent source so that it can be

run at high speed while the lathe spindle runs at a slower speed. This gives the wood tool held in the tool-post a machine screw feed, while the two spindles are in motion at different speeds. The advantages claimed for the device are that an ordinary lathe can be used as a universal milling machine, a universal grinding machine, a high-speed lathe and a dividing engine.

Cincinnati Automatic Extension Reel For Electric Lamps

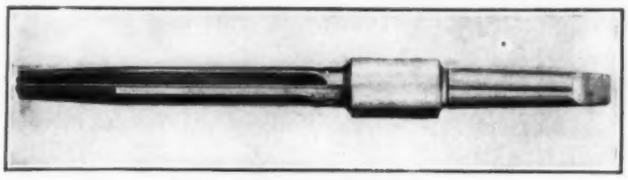
The automatic extension reel for electric lamps illustrated is being marketed by the Cincinnati Specialty Manufacturing Co., Inc., Corner of Powers St. and

EXTENSION REEL FOR ELECTRIC LAMPS

Sylvan Ave., Cincinnati, Ohio. The reel is self-winding, and winds up the electric light cord in a similar manner to that in which the ordinary curtain roller operates. The reel is nine in. in diameter, two in. wide and carries 25 ft. of reinforced cord. The head is intended to be attached to the ceiling and is provided with a swivel joint, which enables the lamp to be carried in any direction from the reel, and an automatic lock enabling a stop may be made at any point. The device is also equipped with a socket handle and lamp guard.

Advance Bridge Reamer

The reamer shown in the illustration is one of the recent products of the Advance Machinery Co., Van Wert, Ohio. The reamers are made with high-steel blades and machine-steel shanks, the blade portions being threaded on slight taper so that they will automatically tighten in the shank. The two may be sep-

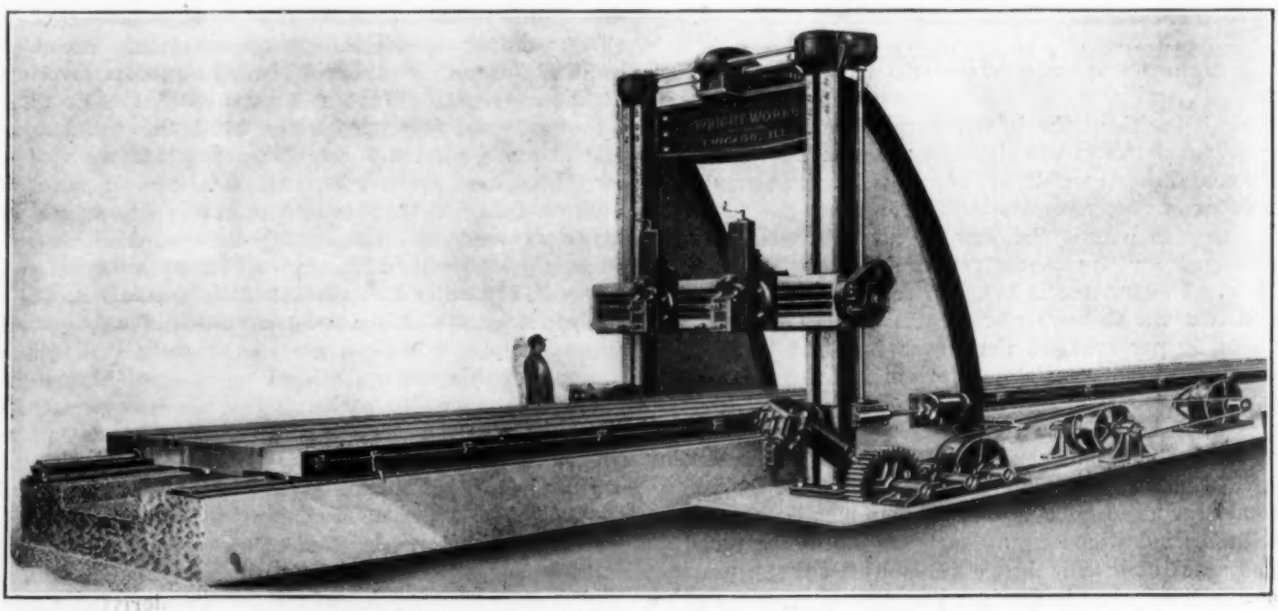


ADVANCE BRIDGE REAMER

arated at any time, which obviates buying new shanks when the reamers are worn out. The device is at present made in four sizes, namely, $\frac{11}{16}$, $\frac{13}{16}$, $\frac{15}{16}$ and $1\frac{1}{16}$ inches.

Wright Concrete Planing Machines

The illustration shows one of a new type of planing machine being built by David A. Wright, 568 Washington Boulevard, Chicago, Ill. The frames of the side housings are made in three cast-iron parts, namely, front, back and base, which are finished and assembled and then filled in with concrete to insure rigidity. The platen is built up of structural steel and equipped with cast-iron T-slots, after which the whole is filled in with reinforced concrete. One way is of ground steel shafting, while the other is flat and of cast iron, both

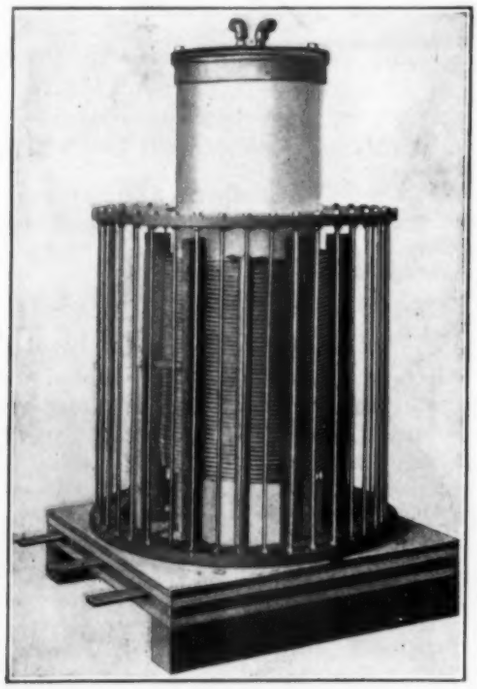


WRIGHT REINFORCED CONCRETE PLANING MACHINES

being set in the concrete foundation. The machines may be equipped with three individual motors, or with a reversing motor as desired, and are equipped with a pneumatic feed. The machine can be made up in any width, varying from 6 to 20 ft. and with any length.

Northrup-Ajax High-Frequency Induction Furnaces

The Pyrolectric Instrument Co., 636-640 East State St., Trenton, N. J., is now marketing the Northrup-Ajax high-frequency induction furnace illustrated, which is adapted in small units for laboratory use and scientific investigations. It is said that these furnaces present a radical departure from the usual furnace practice and embody the first employment of oscillatory current for the generation of heat. By reason of the possible

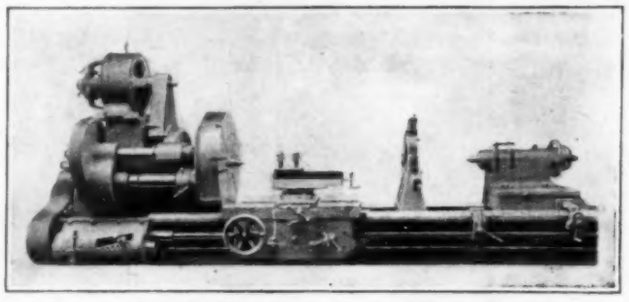


NORTHRUP-AJAX HIGH-FREQUENCY INDUCTION FURNACE OF THE STANDARD VACUUM TYPE

induction without the interlinkage of an iron magnetic with an electrical circuit, currents can be set up in the containing crucible in the case of a non-conducting melt or in the melt itself if this has sufficient conductance to permit the flow of currents. No iron is employed for the concentration of magnetic lines of force. The furnace is intended for single-phase operation and the thermal efficiency is said to range from 40 to 60 per cent. of the power input at the switch terminals. The complete equipment includes the following parts, some of which are omitted on the smaller size of furnace: Switchboard, series reactance with tap-off points, one shunt reactance, one transformer with windings for primary voltage of 110 or 220 volts, condenser units, condenser rack, mercury discharge gap with alcohol dropper and mercury adjuster, furnace, and a set of heavily insulated cables leading from the oscillatory system to the furnace. The furnaces may be used for the heat treatment of metals, for making special alloys, for melting glass and non-conducting materials, for producing temperatures above 1400 deg. C. without the presence of carbon being essentially associated with the operation of the furnace, for producing higher temperatures under controllable conditions of vacuum or pressure and nature of atmosphere, or for other like uses. They are made in five sizes: 6-, 8-, 12-, 16- and 20-kw. capacity.

Pittsburgh 50-Inch Lathe

The Pittsburgh Machine Tool Co., Braddock, Pa., has recently placed on the market the 50-in. lathe shown in the illustration, which is for turning guns, steamship shafts or other heavy work of this character. The ma-



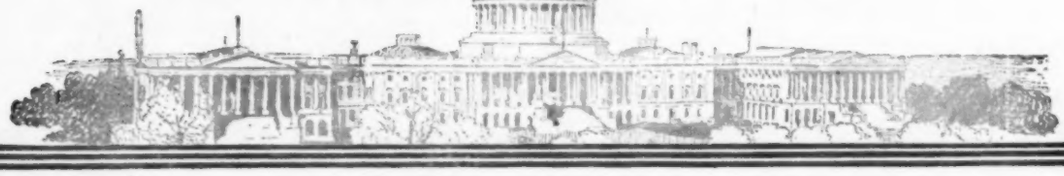
PITTSBURGH LATHE FOR GUN BORING, OR OTHERWORK

chine is claimed to have particularly large bearings, wide bridge on the carriage and cross slides and exceptionally long bearings on the carriage. A double plate apron is used giving double bearings to all apron shafts and all gears of steel. The various feeds are obtained through a quick-change feed box, but the machine may be driven from an individual motor or by means of a belt as desired. When electrically driven the carriage can be equipped with electrically operated quick traverse.

Cost of Air Mail Service

The first report of the comparative cost of the operation and maintenance of the Air Mail Service shows that the airplanes used in this service have broken all records for economy of gas consumption. The total of all the operating expenses of nine airplanes covering flights aggregating 7234 miles was $3682. The total consumption of gas representing 113 hours and 8 minutes of flying was 1377 gal., which is $32.50 an hour—something over 50c. a mile. The total cost of gas was $405 in flying 7234 miles. The best performance in flying was made by a Curtiss J-N-4 machine, which flew 26 hr. and 40 min. at a cost of $28.01 an hour and covered 1719 miles at a cost of 43½c. a mile. A plane equipped with a Hispaño-Suiza 150-hp. engine used approximately 8 gal. of gas an hour, and a plane equipped with a 400-hp. Liberty motor used 17 gal. an hour. This shows 40 per cent. less gas consumed than generally required for airplane engines of these sizes. The calculation of operating cost includes departmental overhead charges, interest on investment, replacement of parts, deadhead time of mechanics, gas, lubricating oils, office force, motorcycles and trucks; rent, fuel, light and telephone; pay of pilots, hangar men and mechanics. The average consumption of gas for the nine planes was 12 gal. an hour.

LATEST ADVICES FROM OUR WASHINGTON EDITOR



Washington, D. C., August 17, 1918.—The machine tool program, about which so much has been said in various ways, is becoming a reality as soon as a few of the details can be determined upon, and these details are subject to considerable discussion at the present time.

The first of these machines are for the huge gun relining equipment for our shops in France and as the machine tools themselves will cost from $12,000,000 to $15,000,000 it is something of a contract and requires careful consideration from all angles. This will include gun boring and turning lathes, rifling and grinding machines in addition to some lathes which come under the engine lathe type but which are for the most part larger than we find in stock. Practically all of these machines must be built for the work, and here is where some of the discussion is coming in.

These lathes will range in size from approximately 50 inches to something over 100 inches and as the guns are long for long range work, the beds present quite a problem in themselves.

In order to build these machines it will, in many cases, be necessary to build machines with which to build the machine tools needed, making the time of delivery somewhat distant. This, however, cannot now be avoided and it is gratifying to find that things have begun to take shape in this line. In one of these cases the builder proposes to build a planer with a concrete bed 500 feet long so as to plane the beds of the boring lathes at one setting and make it easier to line up the bed when it is assembled on the other side. It is further proposed to allow for the curvature of the earth in setting or aligning this planer. Some however seem to feel that, as we nearly always leave a planer a trifle high in the center anyhow, the curvature might help take care of this very nicely and that in any case the amount is hardly worth while figuring.

There is some discussion as to the type of gun lathe to be used and as these lathes are of such large size and can be made by comparatively few shops, it is a question which requires very careful consideration. The question of time required to build, the possibility of failure of a new design, and all the uncertainties which go to make up the problem, require the best experience of the best engineers, and, fortunately, some are being called into consultation on this work. We all desire to see speed along this line but we do not want to go off half-cocked on any such important matter.

As bearing on this case it is interesting to note the claim of one well-known engineer that cast iron in a lathe spindle is much less liable to produce chattered work than a spindle of steel. For this reason he advocates a cast-iron spindle for lathes which are to be used for reaming, as this is where chatter is liable to occur. He points out that while steel tends to produce or at least perpetuate vibrations, cast iron absorbs and silences them. And in proof of this theory suggests that careful note be made of the effect of striking a bar of steel or a bar of cast iron. In this connection it is well to remember that some of the most successful shell lathes had cast-iron spindles and also that large gun lathes have been made with cast-iron spindles in England for many years.

The various kinds of munitions which we need in such large quantities are beginning to come through and it is more than likely that some of our field artillery is already on the other side and doing good work in the present drive. There are also other signs that things are beginning to take definite shape and that when the real program gets into full swing we shall astonish ourselves as well as the rest of the world. Uncle Sammy was some time in getting lined up in some ways, but it is gratifying to see the sort of stride the old man strikes when he really gets down to business.

The strictly functionalized system, which is in vogue in some departments, makes team work a bit difficult, or at least does not point out the necessity of it. This tends to let one part of the program run ahead of the other as has been the case in some instances. This is however being overcome by what may be called the grouping of several functions under one head, so that one man can follow a certain complete unit through from start to finish.

The gun division for example looks after guns of all sizes while the carriage division attends to their part of the program. Now, however, an officer is detailed to see that all the different parts of a complete gun are coming through so as to have the whole unit in service in the shortest possible time. In this way much better team work can be secured and team work is most essential in any sort of an undertaking, especially one of the magnitude of the present job before the Ordinance Department.

This is only one of the many things in which improvements are very noticeable and when we come to know the full extent of our accomplishments, we shall have reason for congratulation in many directions.

The new proposal as to draft ages, from 18 to 45, are causing considerable apprehension in some quarters. But knowing what has been accomplished in the way of sorting out men according to their qualifications, I do not believe we need to be unduly worried. There will

of course be some disturbances to business, that is inevitable. But with the new machinery that is now in operation to keep really essential men where they are, and to utilize the service of others where they can do the most good, we shall have far less disturbance than with the first draft.

Much of course depends upon the local draft boards, but even these are likely to be much more amenable to reason and there is always the Board of Appeals which is earnestly trying to sort men out as they should be. Hearty coöperation with the draft boards, making as few claims and appeals as possible, and a general disposition to boost instead of knock, will help all around.

Another serious problem of the new draft ages is that of the colleges for engineering and other essential courses. There can be no doubt as to the great need of engineers both now and after the war. The President and others high in authority point out the necessity of keeping engineering students at their work.

But the students themselves are not keen on sticking to their books and point out that their professors are conspicuous by their absence so that real progress is difficult to obtain. They further point out that never before in college history have examination marks been so low as last June and there is no chance of improving them. With the best professors gone on war work, Euclid and other ancient gentlemen of academic fame seem tame and uninteresting in comparison with the headlines of the morning papers announcing the capture of a few thousand more prisoners and guns to match.

If the students can be made to feel that they are on a war footing, that their work is really a part of winning the war and afterwards, they may be induced to stick. But the war spirit is too strong to let them sit idly by and appear to be slackers, even if they are not.

Another side issue of the war is that of health insurance of workers of all kinds. The officials of Pennsylvania, who have never been especially keen on the proposition in the past, are now urging State Health Insurance as a war measure. State pride has something to do with this also, as Pennsylvania had nearly 47 per cent. of the first draft rejected as physically unfit, while South Dakota, not a manufacturing state, led by 20 per cent. rejected.

As one side of the question they point to the injustice of quarantining a wage earner without compensation for six weeks on account of the illness of his child, when the sole object of the quarantine was to increase or preserve the health of the community and not of the father. We are certainly making many strides in advance these days.

Byproducts of the War

We are bound to have many byproducts from the war, many of which we do not dream. One line of activity which has been developed is the assisting of manufacturers who find it difficult to get certain raw materials to secure a satisfactory substitute. One such instance is with the white dammar gum used in varnish making, and there are many other cases of interest.

A somewhat different story is that of the research by Capt. O. J. May of the Department of Military Aëronautics who developed a new aëro engine oil which works out well for the Liberty and other motors with stationary cylinders. This is a mineral oil which can be produced for about 75c. a gallon, or one-quarter the cost of caster oil, which has been so widely used in airplane motors. The saving is estimated at about $11,000,000 per year, in addition to that which can be saved by reclamation process which is working out very nicely.

The sad part of it is that Captain May died of overwork last Spring after completing the tests.

The Sales Question in Belgium

By Robert G. Pilkington

I note on page 1099, Vol. 48, the reply of M. Benedictus in regard to the sales question in Belgium after the war. I thoroughly appreciate his courtesy in going into the matter so clearly, as well as the courtesy of the editor. I find that I failed to ask the question in just the right way to elicit a part of the information that is important in connection with the product, which happens to be a new system of sheet-steel construction that, as a friend described it, is so simple that it is foolish. A very prominent Japanese official, whose name cannot be mentioned, recently stopped off while en route to Tokio, to arrange preliminary details for the formation of a Japanese corporation to take care of the business in the Far East, as the construction lends itself readily to buildings intended to withstand damage by earthquake. This is mentioned to give point to the rest of the question.

It is readily granted that experienced organizations, though they are only shells of their former selves, will be in better shape to handle business after the war than new ones, notwithstanding the new ones came into being with a full supply of "pep." However, if we apply the question of sales organizations in Belgium to the handling of a new product of almost universal adaptation, and that will be as staple as salt, the question arises whether it would not be good policy to utilize the old organization as a nucleus, adding to it American capital, or home capital as desired, but recognizing the priority of the old one by allowing it full control.

To apply the question to a specific case, suppose there were in existence an organization that handled a number of mechanical staples; suppose it were approached by accredited people with the proposition that it allow American capital to be added to its going organization, and an exclusive thing be made, say of the beforementioned steel construction. Will the "economic temper" of a Belgian or French organization be such that it will welcome the influx of American capital? This question is asked advisedly, as there is an impression that Belgium and France may have suffered so greatly by the war that every bit of profit accruing to business after the war should be for the benefit of the residents of those countries.

I fear that I have again asked for information in a roundabout way, but M. Benedictus so fully understood me before that I hope he will do so once more. It is of course understood that in such a case the tactful thing would be done, and the necessities of the Belgian or French business men would not be made an excuse for taking over the control of the enlarged organization, but that their experience and the fact that they understood conditions in their own countries would insure that they would control the sales policy entirely.

Selling Machine Tools Abroad

By José J. Prado
Sales Engineer Lucey Manufacturing Corporation

All European markets during the period of reconstruction which will follow the war will be very good markets for machine tools. At the present time Spain seems to be developing an extensive call. Trade could be very much increased if American manufacturers had the proper sources of information as to the requirements of that country, and also if they possessed trade agreements that would not hamper the export of their products. The following suggestions apply especially to Spain and to all the Latin-American countries:

As almost all industries use machinery extensively and require machine tools of some kind, a classified directory of existing and prospective industries will help materially to determine the localities where machine tools are most likely to be demanded in the future.

In Spain especially, but not so in the South American countries, there are several large manufacturing centers of machinery where machine tools must find a good market. As examples large machine-manufacturing plants in or near the cities of Barcelona and Bilbao may be mentioned. Barcelona is the largest and most important industrial city in Spain; Bilbao follows, and in the territory where this city is located exceedingly good iron ore is produced. Production of machinery, if it has not existed on a large scale up to now in this center, is bound to come, and machine-tool manufacturers, in order to get ready to cover this market, should be afforded full information as to its future requirements, type and kind of products, manufacturing capacities, etc.

Directory for Machine-Tool Manufacturers

Central and South American countries show at present, and we believe will show for the next few years, very limited calls for machine tools. Machine manufacturing in these countries amounts to practically nothing, with the possible exception of some shops in the neighborhood of the cities of Rio de Janeiro and Buenos Aires. The countries of Central and South America have calls for machine tools to take care of the necessary repairs to motive-power machinery and general industrial machinery. A good classified directory of these industries in these countries; their size, extent and character and the number of power plants, railway repair shops, marine repair shops, etc., will help machine-tool manufacturers.

Full information as to the amount and character of the demand that existed before the war and that has developed during the past four years will be very helpful in estimating the demand that is likely to develop within the next few years. Also how much of this demand has been supplied; what kind of machine tools have been in use other than those supplied by American manufacturers; what English, German, French and Italian firms have supplied them heretofore, so that the American manufacturer can compare his products with products of similar kind that have already been marketed there and adapt them to the peculiar conditions of the market for which they are destined.

In prewar periods Germany helped local industries in Latin America by furnishing machines and machine tools for exhibition, testing and propaganda purposes. As an example of this the Industrial School of Buenos Aires may be cited. After determining the possible demand it may be well to distribute among such national institutions as the one mentioned sample of machines and machine tools for the purposes mentioned.

American manufacturers should not lose any opportunity to exhibit their products in either local or national expositions, which take place frequently in those countries.

Instructions from the Manufacturer

Our manufacturers did not realize until lately that descriptive literature, pamphlets, catalogs and advertising matter should always be written idiomatically in the language of the buyer; but they should not be contented with merely translating the literature intended for domestic buyers, as domestic methods of trade do not always apply to foreign trade. Domestic buyers generally are well acquainted with the type, size, capacity, etc., of the machine they need, and are mainly concerned in new types, devices, attachments and development of the design with which they are familiar. The foreign buyer, however, in most cases is unfamiliar with the machine. As a rule, he is not thoroughly acquainted with its characteristics, and does not know the several kinds of work it is capable of performing. The demand for the tool or machine, therefore, in many cases, has to be created, and the manufacturer should furnish full instruction as to its operation, installation, cost of performance and upkeep, with illustrations and samples, photographic or otherwise, of the work that it could produce.

The American manufacturer or exporter must be able and ready to quote c.i.f. prices whenever they are required. Foreign buyers often prefer to be advised fully of the cost of the machine at some home port; not uncommonly they request prices delivered at their doors. The import duties of the countries to which machines are to be shipped should be known by the manufacturer, because with such information he could in some measure control its selling prices in cases where he is obliged to carry stock in his foreign offices or with his foreign agents. With this knowledge he would also be better able to help the purchaser.

The American manufacturer should keep in mind that the Latin-American buyer as a rule has no definite idea of what he wants, and aside from creating good-will more than anything else in the trade, it is to the advantage of the manufacturer or exporter to work out for the customer all the engineering propositions connected with his purchases.

French Ordnance Engineers Visit the United States

A mission of French ordnance engineers and experts in the production of ordnance material has arrived in the United States. The head of the mission is Lieut-Col. L. Martinon, for many years in charge of manufacturing at the great French ordnance plant of Schneider & Cie., LeGreuset. The other engineers on the mission are Capt. H. Guillemin, Lieutenants Blanchat, H. Dutilh and P. Perthier and A. Combier. With the mission there are

(Continued on page 366c.)

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

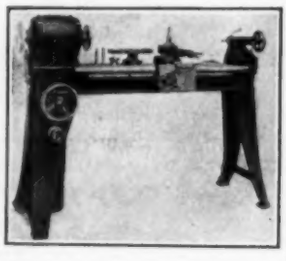
Press, 15-Ton Hand- and Power-Forcing
Atlas Press Co., Kalamazoo, Mich.
"American Machinist," July 18, 1918

This company is now marketing a line of presses, the one shown in the illustration being a 15-ton hand- and power-forcing press. The jaws are adjustable and the screw may be run up or down rapidly to the proper position by means of the handwheel, after which power is applied by drawing down the lever and engaging a catch. A safety device is incorporated which prevents breakage in case the operator should forget to shut off the power. Capacity between jaws, ¾ to 6 in.; distance from floor to jaws, 30 in.; maximum capacity between jaws and screw, 25 in.; distance between columns, 36 in.; weight, 2200 lb.

Magnet, 50-In. Lifting
Ohio Electric & Controller Co., 5900 Morris Ave., Cleveland, Ohio
"American Machinist," July 18, 1918

Known as the company's No. 5, and the features claimed for it are minimum head room, an ample amount of copper in the coil, heat-radiating ribs on the top and bottom and flexible armored leads anchored to the case and welded to the coil. It is claimed that the construction is such that grounds, open ends and short circuits, due to the loosening of internal-screw connections, are obviated. The magnet ring is over 8 in. high and is secured by heavy chrome-vanadium-steel studs with nuts on top of the case protected by ribs raised from the outer rim of the cast-steel case.

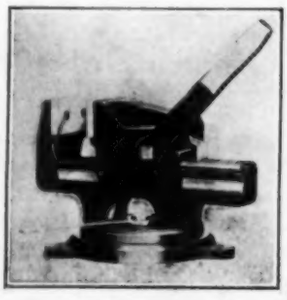
Lathe, Motor-Headstock Alternating-Current No. 51
Oliver Machinery Co., Grand Rapids, Mich.
"American Machinist," July 25, 1918



A four-speed, alternating-current, motor-headstock speed lathe designed for three-phase, 60-cycle, 220-volt current. The illustration shows the machine equipped with hand-feeding carriage and compound-swivel rest, but it can be furnished with plain bed in 4- or 5-ft. lengths so as to turn 24 or 36 in. between centers respectively. The swing is 12 in. Spindle is mounted on ball bearings. The rear end of the motor is fitted with a combined handwheel and faceplate; the outer end is rounded off like a handwheel and the inside face is curved so as to give the advantage of a handwheel shape, but the outer surface is straight and flat and forms a faceplate for rearend turning. The controller is mounted inside the left leg and operated by means of the handwheel shown at the front. Speeds, 570, 1140, 1725 and 3450 r.p.m.

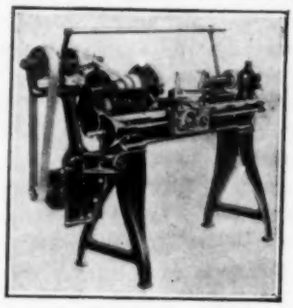
Vise, "Winan's New Idea"
Barnett Foundry & Machine Co., Irvington, N. J.
"American Machinist," July 25, 1918

The customary screw and lever have been replaced by a pawl and rack, these being actuated by a handle on an eccentric shaft. The adjustments are made instantly with a sliding movement, the pawl, eccentric and sliding jaw forming a toggle joint. The moving member of the vise slides away from the operator. The vise may be removed from its swivel base and placed on a surface plate or machine in case this may be convenient. Various sizes are made, the jaws measuring from 3 to 8½ in. and opening from 3½ to 12 in.



Lathe, 12-In. Cone-Head
Shepard Lathe Co., Canal and Jackson Sts., Cincinnati, Ohio
"American Machinist," July 18, 1918

The machine is equipped with a motor mounted on the rear leg, but it can be furnished for a double-friction countershaft drive if so desired. Provided with a semi-quick-change attachment and a reversing mechanism operated by a lever on the headstock. The spindle is of 50-point carbon steel and runs in phosphor-bronze bearings, the drive being by means of a 2-in. belt.

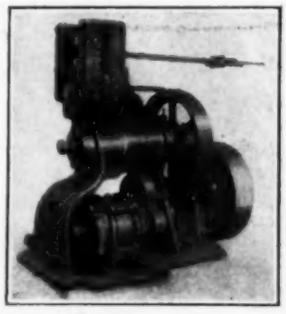


Grinding Machine, Universal Tool and Cutter, No. 6
Coates-Kendall Corporation, 50 Church St., New York City
"American Machinist," July 25, 1918

Swing between centers, 8½ in.; maximum capacity for face mills on universal holder, 18 in.; distance between centers, upper table, 15 in.; distance between centers, lower table, 19 in.; longitudinal feed, 18 in.; cross-feed, 9 in.; vertical adjustment, 8 in.; speed of countershaft, 600 r.p.m.; main-spindle speed, 3000 r.p.m.; internal-spindle speed, 15,000 r.p.m.; chuck capacity, 4 in.; diameter of hole in grinding wheel, ¾ in.; floor space, circle 60 in. in diameter; net weight, 700 lb.

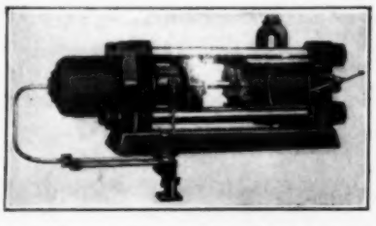
Shears, Drill-Rod, Nos. 2 and 3
Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y.
"American Machinist," July 25, 1918

The No. 2 machine illustrated is arranged to handle stock from about needle size up to and including ½ in. in diameter, while the No. 3 machine is arranged for handling work from ¼ to ¾ in. in diameter. It is claimed that these machines will cut drill rod square and clean and will do it without distorting the end of the bar or leaving marks or flat spots on it. On the No. 2 machine the dies are so made that a separate hole is provided for each size of rod, it being possible to have from 12 to 15 different holes in the dies. Bearings are of bronze and the gears are machine cut. Either machine can be arranged for belt or motor drive, the motor customarily being 3-hp.



Press, Lead-Cable-Covering
Southwark Foundry & Machine Co., Philadelphia, Penn.
"American Machinist," July 25, 1918

The cable to be covered with lead is fed into the press through roller guides in a curved channel, the radius of which is of such size as to prevent danger of bending the cable at too great an angle. The cable then passes through bushings and comes in contact with the molten lead, which fills a ring space between the bushings and the die through which the cable is drawn after being covered with lead. This die smooths out the surface of the lead and reduces the thickness to the proper amount. The molten lead is held in two cylindrical chambers and kept under pressure by means of a hydraulic cylinder.



Patent Applied For

(Continued from page 366a.)

also a score of foremen from French munitions plants. The purpose of this mission is to secure the closest industrial collaboration between the United States and France in order to make the best possible use of the industrial resources of the two countries in the output of ordnance material.

Following the reception by Major General C. C. Williams, Chief of Ordnance, the members of the mission are now engaged in conference with members of the Engineering Division. In the near future the mission will be divided into groups representing the various subjects on which the members of the mission are particularly expert. To each group will be attached officers of the ordnance department who also are experts on these subjects. The group and attached officers will consider not only the engineering features involved, but also inspection and production features, where particular projects are far enough advanced to permit. The groups will visit representative plants where the articles on which they are expert are in manufacture.

The mission visits the United States as the result of a conference between the French Minister of Munitions (Le Minister de L'Armament et des Fabrications de Guerre) and the Chief Ordnance Officer of the American Expeditionary Forces.

It is probable that a mission of American experts and superintendents and foremen of munitions plants and arsenals will visit France after the return of the French mission, which will be in about three months.

Special Training for Army Mechanics

A committee on education and special training of the War Department has introduced an entirely new feature in its course for soldiers who are being trained as mechanics in various places. The purpose of this special training is to increase the morale of the soldiers under training by giving them a clear and definite idea of what the war is about and of the supreme importance to our democracy of the cause for which we are fighting. An experimental course of this nature given in Boston demonstrated the great value of such work when properly conducted and added greatly to the enthusiasm of the men to do their part in the winning of the war.

Each school where these mechanics are trained is now asked to nominate one instructor for each 50 men, each class to meet once a week and to be held by the same instructors during each of the eight weeks of the course. Furthermore, each instructor is asked to set apart a regular time, preferably in the evening, at the barracks, when the men can consult him individually about matters that have puzzled them.

A syllabus of the points to be covered is to be prepared and sent to the instructors in charge of the work, together with a collection of publications of the Committee on Public Information and other agencies which supply the necessary facts in convenient form. This will cover the events leading up to the outbreak of the war in August, 1914, the events that compelled the United States to enter the war in 1917, the forms of government, the character and national aspirations of the countries against which we are fighting, and also of the nations on our side, especially France, Great Britain, the self-governing English colonies and Italy.

Transportation Problems and Population

Some of our national transportation problems and difficulties can be better understood when it is remembered that in the northeastern section of the United States, including New York, Pennsylvania, adjoining states, and New England, the population is 693 persons to every mile of railroad; in the South the figures are 407 persons per mile; and in the West, 252. There are 15 square miles of land to every mile of railroad in the West, while in the East there is one mile of railroad to every five square miles of land. There are innumerable factories in this eastern section and the bringing in of coal and raw material and the carrying out of manufactured products make up a tremendous freight tonnage. The Railroad Administration is gradually solving many problems. By the elimination of unnecessary passenger trains several thousand engines are diverted from passenger to freight traffic, which relieves the situation materially. Also by loading the freight cars to full capacity a great saving is being accomplished. Routeing freight by the most direct route and other methods adopted by the administration are doing much to ease the strain on our transportation facilities.

Control of Small-Tool Manufacture

Great Britain, through the Minister of Munitions, has assumed control of the manufacture of all small tools and small-tool parts. This means that a license is now necessary before engaging in the manufacture of these tools, which include the following list: Abrasive wheels, adjustable clamps, auger bits, band saws, boring heads, calipers, chasers, chucks, circular saws, dial gages, dies and die stocks, die heads, drills, drill sleeves and sockets, emery-wheel dressers, expanding mandrels, expansion bits, files, furniture and dovetail bits, gages, hacksaw blades, hand and breast drills, hand grinders, hide hammers, lathe carriers, lathe dogs, lead hammers, machine vises, measuring tapes and rules of all description (including verniers), micrometers, milling cutters, pipe cutters, pipe vises, pipe wrenches, pliers, punches, reamers, screwing tackle (that is, chasers, dies and stocks, taps and thread-milling cutters), swage shapers, tapping attachments, taps, tap wrenches, tool holders, tube expanders and wood-boring bits.

New St. Louis Ordnance District

The Ordnance Department announces that the St. Louis Ordnance District, recently created, will include the states of Missouri, Arkansas, Oklahoma, Texas, Kansas, Nebraska, Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, Oregon, Nevada and California. It will also include all that territory in the state of Illinois south of the northerly boundaries of the following counties: Adams, Schuyler, Cass, Macoupin, Christian, Shelby, Cumberland and Crawford.

The date on which the St. Louis district office will open will be given later. As previously announced M. E. Singleton of St. Louis is to be ordnance district chief.

The territory embraced in the new St. Louis district now is administered by the Chicago district office.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Bending Machine, No. 16

Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y.

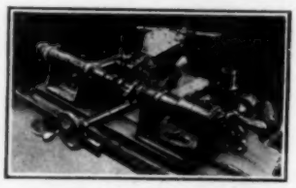
"American Machinist," July 25, 1918

This machine is claimed to be the only bender that will bend material into a perfect circle leaving the piece free from flat spots at either end. The top roll is adjustable and detachable so that the proper size can be put on to roll the circle desired, the material being bent tightly around this upper roll. The two lower rolls are adjustable up and down and are mounted by means of an eccentric sleeve so that they may be tightened or loosened while the band is being bent. The machine can be made up as desired for various sizes and classes of work.

Grinding Machine, Thread-Gage

Community Machine & Tool Works, 154-156 Grand St., New York City

"American Machinist," July 25, 1918

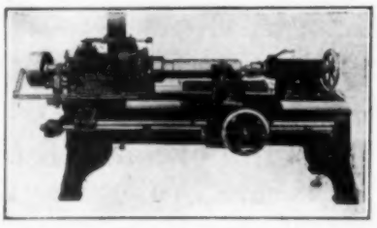


The machine is for grinding thread gages, the work being carried on centers. The grinding wheel is held in a fixed position and the work is rotated and moved past it by means of the crank attached to the spindle which carries a master screw of the same lead as the thread gage being operated upon. The work is given a corresponding rotary and longitudinal motion by means of a driving dog, the dead center at the left of the machine being held to the work by means of a spring. An attachment for truing the grinding wheel is an integral part of the machine, a back-and-forth motion of the lever seen at the rear serving to carry two diamond holders alternately across the two faces of the grinding wheel.

Lathe, Shell-Turning, "Hindman"

Duff Manufacturing Co., Pittsburgh, Penn.

"American Machinist," July 25, 1918

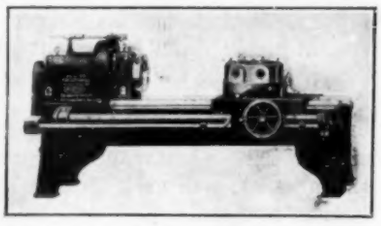


Swing over ways, 20 in.; swing over carriage, 9 in.; distance between centers with 8-ft. bearings, 38 in.; front spindle bearing, 5 x 7⅝ in.; spindle nose, 2¾ x 4 1/16 in., threaded for U. S. S., 4 pitch; size of hole in spindle, 1½ in.; centers, Morse No. 6; diameter of driving plate, 11 in.; feed regularly furnished, 0.125 in.; optional feeds, 0.020 to 0.100 in.; diameter of tailstock spindle, 4½ in.; travel of tailstock spindle, 8 in.; width of bridge, 10 in.; size of tools regularly used, 2 x ¾ in.; width of belt, 5 in.; back gear ratios, either 25.3, 18¼, 14¼ or 11 to 1, as desired; length of carriage, 30 in.; feed screw, 2 in. diameter, 4 pitch; width of bed over shears, 26½ in.; depth of bed, 16 in.; pitch of feed gears, 6; weight with 8-ft. bed, approximately 6000 lb.

Lathe, Shell-Boring, "Hindman"

Duff Manufacturing Co., Pittsburgh, Penn.

"American Machinist," July 25, 1918

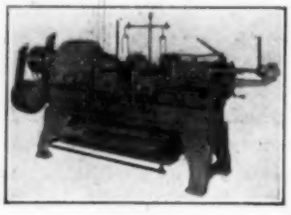


Swing over ways, 20 in.; distance from face of turret to face of spindle, 33 in.; front spindle bearing, 9½ in. in diameter and 7½ in. long; spindle nose, 14½ in. diameter and 3 in. long; size of hole regularly furnished in spindle, 7½ in. in diameter and 25 7/16 in. deep; feed regularly furnished, 0.060 in.; optional feeds, 0.20 to 0.125 in.; distance across flats of turret, 18 in.; size of hole for bar, 3 in.; back gear ratios, 25.3, 18¼ or 11 to 1, as desired; length of carriage, 30 in.; feed screw, 2 in. in diameter, 4 pitch; width of bed over shears, 26½ in.; depth of bed, 16 in.; pitch of feed gears, 6; approximate weight with 8-ft. bed, 6000 lb.

Lathe, Three-Operation Shell "Wolff"

Buffalo Pitts Co., Buffalo, N. Y.

"American Machinist," July 25, 1918

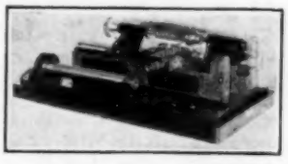


A combination machine for cutting off the open ends of shell forgings to a predetermined length from the inside of the base, for drilling a center in the outer surface of the base and for facing the outer surface of the base to a given dimension from the inside surface. The advantages claimed for this machine are that the three operations are performed on one machine and with one handling, the first and third operations being performed simultaneously.

Testing Machine for Lead of Thread Gages

Sheffield Machine & Tool Co., Dayton, Ohio

"American Machinist," July 25, 1918

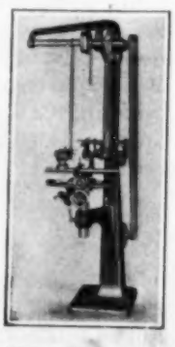


Consists primarily of a cast-iron bed machined all over with two parallel dovetail bearings on the top. On the rear and larger bearing is mounted the centers for holding the gage to be tested and upon the front bearing is fitted the sliding block which carries the indicator slide. Upon this slide is mounted the indicator, held in place by means of a small hardened stud which is clamped in position with a small headless setscrew. The device is practically a holding fixture for the work and measuring device and the measurements are dependent upon the Johansson gage blocks and the Deming precision indicator which are used.

Grinding Machine, Universal Tool and Cutter

Thompson Grinder Co., East Main and Murray Sts., Springfield, Ohio.

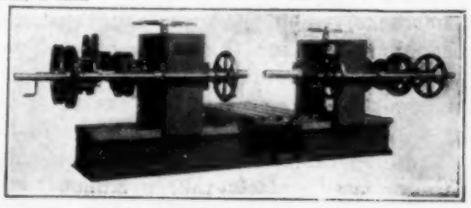
"American Machinist," July 25, 1918



The illustration shows the self-contained motor-driven machine, but it is also made up in a self-contained style driven from a jack-shaft located on the column in place of the motor, and in a style belt-driven from an overhead countershaft. A distinctive feature of the machine is the fixed and immovable grinding wheel. The machine is fully universal, and cylindrical-, surface- and internal-grinding attachments are furnished. The machine is furnished with a large number of attachments including one for concave and convex work. Capacity between centers, 8 x 12½ in.; longitudinal travel, 15 in.; transverse travel, 4½ in.; vertical travel, 10 in.; net weight, 580 lb.; gross weight, 730 lb.

Boring Machine, Duplex Horizontal

Pedrick Machine & Tool Co., 36-40 N. Lawrence St., Philadelphia, Penn.



"American Machinist," August 1, 1918

Made in two sizes with specifications as follows: Diameter of bars, 3 or 6 in.; length of bars, 4 ft. 6 in. or 6 ft. 8 in.; minimum distance from center of bars to bed, 6 in. or 9 in.; maximum distance from center of bars to bed, 23 or 28 in.; travel of bars, 16 or 21 in.; maximum distance between bars, 63 or 47 in.; taper of holes in boring bars, Morse No. 5 or 6; size of bed, 21 in. wide, 18 in. high, 9 ft. 6 in. long; size of cross-table, 24 in. wide, 4½ in. high, 48 in. long; travel of cross-table, 30 in.

Patent Applied For

Personals

J. Hay has been made master mechanic of the Grand Trunk Lines in New England, with headquarters at Portland, Me.

C. C. Higgins, until recently assistant to the vice president of the Frisco lines, has been given charge of the mechanical department.

David S. Wegg, Salt Lake City, Utah, is now a supervising inspector of ordnance material in the Chicago district with headquarters at the plant of the Standard Steel Car Co., Hammond, Ind.

J. H. Garden has become master mechanic of the Grand Trunk R.R., at Stratford, Ont., Canada. He formerly held the same position with the Grand Trunk R.R., at Battle Creek, Mich.

C. B. Banch, formerly in the employ of Corrigan, McKinney & Co., Cleveland, Ohio, as designing engineer, is now holding a position with the U. S. Steel Corporation, Ordnance Department, Ambridge, Penn.

Charles W. Vocke has become associated with the National Aniline and Chemical Co., Wappingers Falls, N. Y. Mr. Vocke was formerly mechanical engineer with the Nitrogen Fixation Corporation, New York.

L. L. Bannon has resigned his position as superintendent of the plant of the Weatherby Foundry and Machine Co., Weatherby, Penn., and has gone to the Bonney Vise and Tool Works, Allentown, Penn., as their superintendent.

Arthur Seubert has entered the service of the New York Edison Co., New York, as assistant to the mechanical engineer. Mr. Seubert was formerly an instructor in mechanical engineering at the Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

G. E. Sisco, who was master mechanic of the Pennsylvania lines, west of Toledo, has been transferred to the Logansport division in the same capacity, with office at Logansport, Ind. He succeeds **O. C. Wright,** who was recently promoted to another position.

William F. Parish has assumed the duties of chief of the oil and lubrication branch of the Supply Section of the Department of Military Aeronautics. Mr. Parish was formerly aeronautical mechanical engineer, Signal Corps, Equipment Division, Specification Section.

F. J. Monahan has been made master mechanic of the Birmingham division of the Louisville & Nashville R.R., with an office at the shops in Boyle, Ala. Mr. Monahan is succeeded by **T. H. Hogan,** who has been appointed master mechanic of the Memphis line with an office at Paris, Tenn.

R. H. Flinn, formerly assistant engineer of motive power of the Central system, succeeds Mr. Mechling as master mechanic at Terre Haute, and **C. W. Kinnear,** formerly assistant master mechanic at Dennison, Ohio, succeeds Mr. Flinn as assistant engineer of motive power at Toledo.

F. Raymond Jackson, has secured a position in the Mechanical Section, Department of Concrete Ship Construction, of the Emergency Fleet Corporation, United States Shipping Board, Philadelphia, Penn. He was formerly connected with the firm of J. E. Sirrine, mill engineer and architect, Greenville, S. C.

Charles F. Merrill has given up his position as chief engineer of the James Hunter Machine Co., North Adams, Mass., to take a position in the Southern sales department of the Draper Corporation at Atlanta, Ga. He was connected with the engineering department of the Draper organization at Hopedale, Mass., for a number of years.

Arthur W. Berresford, who is vice president and general manager of the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has received the appointment as representative of the Milwaukee employers on the Community Labor Board created to coöperate with the State War Labor Board in the new Government labor-control program.

W. S. Galloway, until recently assistant purchasing agent of the Baltimore & Ohio R.R., at Baltimore, Md., has bene made purchasing agent of the Baltimore & Ohio Eastern lines and New York terminals, the Western Maryland, the Cumberland Valley, the Cumberland & Pennsylvania and the Coal & Coke, having offices at Baltimore, Md.

A. N. Ostberg, formerly mechanical inspector of the Chicago, Burlington & Quincy R.R., with an office in Chicago, Ill., has been made mechanical engineer of valuation. He succeeds **W. H. Davis,** who has been appointed office engineer in the department of inspection and tests of the United States Railroad Administration at Washington, D. C.

T. B. Farrington, formerly assistant master mechanic of the Pennsylvania Western lines, Southwestern system, with office at Columbus, Ohio, has been made master mechanic of the Michigan division, with office at Logansport, Ind. He succeeds **J. R. Riggs,** who was recently appointed master mechanic of the Central system, Toledo division, with office in Toledo, Ohio.

E. J. Brennan, formerly general master mechanic of the Baltimore & Ohio, with office at Pittsburgh, Penn., has been made superintendent of motive power of the Chicago, Milwaukee & St. Paul lines east of Mobridge, with office at Milwaukee, Wis.

W. F. Walsh, formerly traveling mechanical expert of the Galena Signal Oil Co., with an office at Chicago, has been made assistant superintendent of motive power of the Southern district of the Chicago, Milwaukee & St. Paul R.R., with headquarters at Dubuque, Iowa.

Business Items

The Feeney Tool Co. has just moved from Middle St. to its new plant at 751 Central Ave., Bridgeport, Conn., thereby greatly increasing its facilities.

The Atlantic Manufacturing Co., 20 New Haven Ave., Milford, Conn., is now occupying its new factory at the above address, where it has increased facilities for producing screw-machine products.

The Pacific Tool and Supply Co. of San Francisco and Los Angeles, with offices in Portland and Seattle, has been made agent for California, Washington and Oregon, for "Fulflo" pumps manufactured by the Fulflo Pump Co., Blanchester, Ohio, and will carry a stock of pumps at San Francisco and Los Angeles.

The Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago, Ill., has opened a new welding shop and is prepared to do all kinds of repairing of broken automobile parts and machinery. This department occupies a new building 50 x 150 ft. Special attention will be given to manufacturers who have Government contracts to make tanks, cans, containers, ovens, etc., which require the joining of metal to metal. The oxyacetylene-welding process is used in this shop.

Catalogs Wanted

Tools, Jigs, Fixtures, Etc. The Singer Engineering Co., 149th St. and Third Ave., New York, desires to obtain catalogs of the above-mentioned equipment.

Catalogs, handbooks, manuals, instruction sheets and other trade literature available for free distribution, and of a mechanical nature, are desired by the Public Library, Detroit, Mich., for use in its newly organized Technology department.

Trade Catalogs

The Elapsed Time Records. Calculagraph Co., Hudson Terminal Building, 30 Church St., New York. Catalog. Pp. 22; 6 x 9¼ in. This catalog illustrates and describes how elapsed time may be mechanically recorded for various kinds of work. It shows a number of record cards of different colors for different departments of a machine shop.

Taps, Dies and Screw Plates. S. W. Card Manufacturing Co., Mansfield, Mass. Catalog No. 29. Pp. 158; 5 x 7¼ in. This catalog cancels all previous editions. It gives prices and sizes of chasers, clamp collars, collets, dies, die holders, guides, reamers, screw plates, screw-plate stocks, tap wrenches, taps and threads. Tables of information are also given.

Bulletin of the Bureau of Standards. Department of Commerce, Washington, D. C. The following are its contents: Relative sensibility of the average eye to light of different colors and some practical applications to radiation problems; calculations of the constants of Plauck's radiation equation: an extension of the theory of least squares; luminous radiation form a black body and the mechanical equivalent of light; an experimental study of the Fahy permeameter; note on electrical conduction in metals at low temperatures; reflecting power of tungsten and stellite, and a method for testing current transformers.

New Publications

Heating and Ventilation—By John R. Allen and J. H. Walker. Three hundred and five 6 x 9-in. pages; 172 illustrations and 76 tables. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price, $3.

This book is intended as a textbook on the subject of heating and ventilation for use in engineering and architectural schools. Professor Allen, dean of the department of engineering and architecture in the University of Minnesota, and Mr. Walker, superintendent of central heating in the Detroit Edison Co., make an especially good team for the compilation of a book of this kind. The development of working methods of design and the inclusion of various tables and charts make the book of much value as a handbook for the practicing engineer and architect. Calculus has been employed to some extent in developing certain expressions for the sake of completeness. Students and others not equipped with a knowledge of higher mathematics may omit such parts without destroying the value of the book. Problems are given at the end of many of the chapters in order to illustrate the principles expressed, but they can be profitably supplemented by actual designing by the student of complete heating and ventilating systems for various types of buildings. The chapters deal with heat, heat losses from buildings, different methods of heating, properties of steam, radiators, steam boilers, steam-heating systems, pipe fittings, valves and accessories, steam piping, hot-water systems, automatic temperature control, air and its properties, ventilation, hot-air furnace heating, design of fan systems, air washers and air conditioning, fan systems for various types of buildings, and central heating.

Forthcoming Meetings

American Foundrymen's Association and the American Institute of Metals will hold a joint convention in Milwaukee, Wis., Oct. 7-12. In connection with these meetings there will be an exhibition of foundry equipment, machine tools and accessories.

American Gear Manufacturers' Association will hold its semi-annual meeting at the Onondaga Hotel, Syracuse, N. Y., Sept. 19, 20 and 21.

American Society of Mechanical Engineers. Monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Traveling Engineers' Association will hold its twenty-sixth annual convention in Chicago, Ill., on Sept. 10, 1918. W. O. Thompson, general offices, New York Central R.R., Cleveland, Ohio, is the secretary.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$47.00
No. 2X, New York	34.40	34.40	53.00
No. 2 Northern Foundry, Chicago	33.00	33.00	55.00
*Bessemer, Pittsburgh	35.20	36.60	55.95
*Basic, Pittsburgh	32.00	32.00	52.95
No. 2X, Philadelphia	34.40	34.40	54.50
*No. 2, Valley	33.00	33.00	53.00
No. 2 Southern Cincinnati	36.90	36.90	49.90
Basic, Eastern Pennsylvania	32.90	32.90	50.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.245	$4.245	$5.25	$4.17	$4.50	$4.27	$5.00
Soft steel bars	4.145	4.145	5.00	4.07	5.00	4.17	4.50
Soft steel bar shapes	4.145	4.145	5.00	4.17	4.50	4.17	4.50
Soft steel bands	4.995	4.995	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.495	4.495	10.00	4.42	8.00	4.25	8.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$5.25
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.10	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.495	6.495	10.50	6.42	9.00	6.52	10.00
*No. 26 black	4.90	6.395	6.395	10.40	6.32	8.90	6.42	9.90
*Nos. 22 and 24 black	4.85	6.345	6.345	10.35	6.27	8.85	6.37	9.85
Nos. 18 and 20 black	4.80	6.295	6.295	10.30	6.22	9.20	6.32	9.80
No. 16 blue annealed	4.45	5.695	5.695	10.20	5.62	9.20	5.72	10.20
No. 14 blue annealed	4.35	5.595	5.595	10.10	5.52	9.10	5.62	10.10
No. 10 blue annealed	4.25	5.495	5.495	10.00	5.42	9.00	5.52	10.00
*No. 28 galvanized	6.25	7.745	7.745	12.50	7.67	10.75	7.77	11.50
*No. 26 galvanized	5.95	7.445	7.445	12.20	7.37	10.45	7.32	11.20
No. 24 galvanized	5.80	7.295	7.295	12.05	7.22	10.30	7.47	11.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 12%	List plus 25%
Cleveland	List plus 12%	List plus 10%
Chicago	List plus 13%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.50–19	$14.00
Cleveland	20.00	13.30
Chicago	19.00	12.50

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
¼, 11, 5/16, 3/8, 7/16, 1/2 No. 8, 5/8 and 25, 10	22.10 to 33.00	1/4 by 12 in. long	16.00
1/8		1/4 by 18 in. long	14.00
No. 12		5/16 by 19 in. long	12.00
3/32, No. 14 and 1/16		3/8 by 21 in. long	12.00
No. 18			
No. 20		*Special Welding Wire	
		1/8	33.00
		5/32	30.00
		3/16	28.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.15	4.07	4.17
Toe calk	5.75	4.65	4.32
Openhearth spring steel (heavy)	8.00	8.00	7.60
Spring steel (light)	11.00	11.25	11.90
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.99½	4.75	5.02
Cold-rolled strip steel	8.50	8.25	8.57
Floor plates	6.50	6.00	7.07

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17½%	⅜ to 1½	33%	17%
½	48%	33⅓%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼, ⅜ and ½	40%	22½%	¾ to 1½	33%	18%
⅝	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
⅜ to 3 in. steel butt welded	33%	16%	43%	28%	41.9%	26.9%
3½ to 3 in. steel lap welded	15%	+3%	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 10 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	26.00*	26.00	28.50
Tin in 5-ton lots	91.50	96.00	63.75
Lead	8.75	7.82	11.00
Spelter	9.00	8.62	8.75

*Government price.

ST. LOUIS

Lead	8.50	7.75	10.75
Spelter	8.75	8.50	8.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	38.00	36.25	38.00	38.00	40.00	33.50	39.40
Copper wire (carload lots)	35.00	31.00	38.50	35.00	39.00	33.00	38.50
Brass Sheets	39.75	37.75	40.00	37.00	40.00	31.50	42.00
Brass pipe	46.00	44.00	43.00	42.00	43.00	41.50	46.00
Solder (half and half) (case lots)	60.00	70.00	39.25	62.00	39.50	56.00	39.25

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$32.25	$34.00
New York	34.25	38.00
Cleveland	35.00	38.00
Chicago	29.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	18.75	21.00	18.40	21.50
New York	16.50	23.00	17.00	23.25
Chicago	22.00	22.50	21.50	23.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.50	13.00
Chicago	15.25	16.00
Cleveland	16.25	16.50

SHOP MATERIALS AND SUPPLIES

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current 1918	New York One Yr. Ago	Cleveland Current 1918	Cleveland One Yr. Ago	Chicago
Copper, heavy and crucible	24.00	24.00	24.00	26.75	23.50
Copper, heavy and wire	22.50	23.00	23.50	26.00	23.25
Copper, light and bottoms	20.50	21.00	21.50	23.00	21.50
Lead, heavy	7.00	8.50	.....	9.75	7.50
Lead, tea	5.25	6.50	7.50	7.75	6.50
Brass, heavy	14.75	16.00	16.00	18.00	23.50
Brass, light	11.00	12.00	12.50	14.00	13.00
No. 1 yellow brass turnings	13.50	15.50	14.00	15.00	13.50
Zinc	6.00	6.00	6.50	7.00	6.25

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, guaranteed over 99% pure, in ingots for remelting (1-15 ton lots), per lb.	33.20c.	32.20c.	33½c.

This is the Government price for lots of from 1 to 14 tons.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	32.00	38.00
Chicago	38.00	39.00
Cleveland	36.50	41.00

BABBITT METAL—Warehouse price per pound:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Best grade	125.00	70.00	108.00	71.75	100.00	70.00
Commercial	70.00	40.00	23.00	24.50	24.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Hot pressed square	$2.50*	List	$1.20	$1.65	$1.05	$3.00
Hot pressed hexagon	2.50*	List	1.00	1.50	.85	3.00
Cold punched square	2.50*	List	.75	1.40	1.00	1.60
Cold punched hexagon	2.50*	List	.75	1.40	1.00	2.00

* List plus.

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50%
Chicago	50%	50%
Cleveland	60%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	30%	45%	37%
Larger and longer up to 1 in. by 30 in.	15%	37%	25—5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $2.50 Cleveland ..... $1.50 Chicago $2.50

For cast-iron washers the base price per 100 lb. is as follows:
New York ..... $5.00 Cleveland ..... $4.00 Chicago $3.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
⅝ by 4 in. and smaller	30%	45%	37%
Larger and longer up to 1 in. by 30 in.	15%	30%	25—5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	Rivets One Year Ago	Burs Current	Burs One Year Ago
Cleveland	List plus 10%	List plus 10%	List plus 10%	List plus 10%
Chicago	List price	List price	List plus 20%	List price
New York	20% from list	List plus 10%	List plus 20%	10-2½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ¼ and smaller	30%	45—5%	45%*
Tinned	30%	45—5%	45%*

Button heads, ¾, ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.
New York..$5.65 Cleveland..$5.15 Chicago..$5.67 Pittsburgh..$4.65

Coneheads, same sizes:
New York..$5.75 Cleveland..$5.25 Chicago..$5.77 Pittsburgh..$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	49.00	42.50	39.50
Brass	40.00	40.00	44.00

For immediate stock shipment 3c. is usually added. The prices of course vary with the quantity purchased. For lots of less than 100 lb. but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb. but not less than 50 lb., the advance is 2½c. over base (100-lb. lots); for less than 50 lb. but not less than 25 lb., 5c. should be added to the base price; and for quantities under 25 lb. the increase above base is 10c.

TIN PLATES—Warehouse prices per box:

Coke tin plate, 14 x 20:

	Cleveland Current	Cleveland One Yr. Ago	Chicago Current	Chicago One Yr. Ago
100 lb.	$10.00	$12.00	$10.60	$11.75
I. C. 107 lb.	10.15	12.17½	10.70	11.90

Terne plate, 20 x 28:

Base Weight	Net Weight	Coating				
100 lb.	200	3	18.95	18.70	19.10	17.50
I. C.	214	8	19.25	19.00	19.40	17.85
I. C.	270	8	21.75	21.50	21.40	19.95
I. C.	218	12	21.75	19.85	22.60	18.85
I. C.	221	15	22.50	20.35	22.10	19.10
I. C.	226	30	23.25	21.75	22.60	20.15
I. C.	231	25	24.50	22.20	23.10	20.90
I. C.	236	30	25.75	23.50	23.60	21.85
I. C.	241	35	26.75	24.50	25.10	22.85
I. C.	246	40	28.00	25.75	25.60	24.15

NOTE—New York prices furnished on application to dealers. Price varies according to whether the plates are wanted for work essential to the war or for nonessential work.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	New York One Year Ago	Cleveland	Chicago
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	12.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 13¼	13¼ x 20½
Cleveland	52.00	68.00
Chicago	48.00	50.00

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.40	2.40	2.00
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$4.30	$4.30	$2.85
Cleveland	4.60	4.50	4.60
Chicago	4.00	4.00	3.25

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Aug. 15	Aug. 8	Aug. 1	July 25	July 17
Prompt furnace	$6.00	$6.00	$6.00	$6.00	$6.00
Prompt foundry	7.00	7.00	7.00	7.00	7.00

FIRE CLAY—The following prices prevail:

		Current
Chicago	450-lb. bbl.	$2.50
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Yr. Ago
Raw in barrels	$1.86	$1.26	$2.10	$1.20	$2.05	$1.17
5-gal. cans	1.96	1.35	2.25	1.35	2.25	1.27

WHITE AND RED LEAD in 500-lb. lots sells as follows in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Year Ago Dry and In Oil
100-lb. keg	14.00	14.50	13.25	13.50	14.00	13.00
25 and 50-lb. kegs	14.25	14.75	13.50	13.75	14.25	13.25
12½-lb. keg	14.50	15.00	13.75	14.00	14.50	13.50
5-lb. cans	——	——	15.25	15.50	16.00	15.50
1-lb. cans	——	——	15.25	15.50	17.00	15.50

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

WASHINGTON, D. C.

The Navy aims to give information regarding its purchases to all manufacturers known to be in a position to supply its demand. Owing to the need of prompt action in the cases of all machine tools hereinafter listed, the Navy cannot arrange to permit a postponement of the opening of bids if the manufacturers are able to secure bidding forms and submit their bids prior to date fixed for opening.

In case time does not permit this, it will be appreciated if any manufacturer not receiving information directly regarding these purchases will notify the Purchasing Division, Bureau of Supplies & Accounts, Navy Department, Washington, D. C., in order that the firm's name may be properly listed for all future purchases.

The Bureau of Supplies and Accounts, Navy Department, will receive bids for furnishing machines and machine tools, as follows:

September 3rd—Schedule No. 5379½, auto gear cut machine; delivery Newport, R. I. Noted Aug. 8.

Schedule No. 5382½, lathes, delivery Pensacola, Fla. Noted Aug. 8.

Schedule No. 5383½, plain milling machine, delivery Newport, R. I. Noted Aug. 8.

Schedule No. 5428½, spot welding machine, delivery Portsmouth, N. H.

Schedule No. 5436½, slip roll forming machine, delivery Wash., D. C.

Schedule No. 5437½, planers and knives, delivery Wash., D. C.

Schedule No. 5474½ table and disc grinder, delivery New York, N. Y.

Schedule No. 5475½, lathe, delivery New York, N. Y.

The Bureau of Supplies and Accounts, Navy Department, received bids for furnishing machines and machine tools, as follows:

Schedule No. 5114½, Class 795, (Item 1) —1 geared head engine lathe; Class 796, (Item 2)—1 portable electric hand drill, Class 797, (Item 3)—1 motor driven, tool grinder; Class 799, (Item 5)—one 21 in. wheel and lever, back gear drill press, to drill hole up to 1½ in.; Class 798, (Item 4) —pipe threading machine, delivery Naval Hospital, Norfolk, Va., from Kemp Machine Co., 223 North Calvert St., Baltimore, Md., (1) $2242, alternate $1614; (2) $68; (3) $122, (5) $598, alternate $420, (4) $737; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., (1) $2335, alternate $2535, (2) $53, (3) $102, (5) $425, alternate $440, (4) $475; Niles, Bement & Pond, 111 Broadway, New York City, (1) $2110, (3) $345, (5) $370, (4) $1125; D. Saunders, Inc., 21 Atherton St., Yonkers, N. Y., (1) $1505 f.o.b.; Sherritt Stoer Co., Finance Bldg., Philadelphia, Penn., (1) $2725, (3) $282, (5) $351, (4) $870; Whitcomb-Blaisdell Machine Co., 134 Gold St., Worcester, Mass., (1) $2186; Fairbanks Co., Colorado Bldg., Wash., D. C., (1) $1986, (2) $50, (5) $380, (4) $770; Chicago Pneumatic Tool Co., 143 South Dearborn St., Chicago, Ill., (2) $59; Independent Pneumatic Tool Co., 1307 Michigan Ave., Chicago, Ill., (2) $50; Hoefer Manufacturing Co., 155 Chicago St., Freeport, Ill., (5) $710, alternate $550; Landis Machine Co., Waynesboro, Penn., (4) $1539; Oster Manufacturing Co., 2057 East 61st Place, Ohio, Cleveland, (4) $403.

Schedule No. 5115½, Class 804, (Item 3) —1 plain belt driven 42 in. radial drill; Class 805, (Item 10)—two ⅝ in capacity portable electric drills; delivery Navy Yard, Brooklyn, N. Y., from Fairbanks Co., Colorado Bldg., Wash., D. C., (3) $2190; Kemp Machine Co., 223 North Calvert St., Baltimore, Md., (3) $625, (10) $119; Mueller Machine Tool Co., 2427 Colerain Ave., Cincinnati, Ohio, (3) $1605; Manning, Maxwell & Moore, Inc., 119 West 40th St., New York City, (3) $3046, (10) $118; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., (3) $1860; (10) $94; Niles, Bement & Pond, 111 Broadway, New York City, (3) $1840; Henry Prentiss, 149 Broadway, New York City, (3) $2100; Swind Machine Co., Widener Bldg., Philadelphia, Penn., (3) $2250; Somers, Fitler & Tood Co., 327 Water St., Pittsburgh, Penn., (3) $2166; Hisey Wolff Machine Co., Colerain Ave. and Marshall St., Cincinnati, Ohio, (10) $113.

Schedule No. 5185, Class 834, (Item 1) —1 oil grooving oil machine, delivery Naval Torpedo Station, Newport, R. I., from W. E. Davis Machine Co., 945 Pennsylvania Ave., Wash., D. C., $483; Garvin Machine Co., 139 Varick St., New York City, $1384; alternate $825; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., $525, alternate, $946; Swind Machine Co., Widener Bldg., Philadelphia, Penn., $528, alternate $750.

Schedule No. 5247½, Class 846, (Item 1) —1 worm geared crane ladle, with a capacity of 20,000 lbs., delivery Navy Yard, Wash., D. C., from J. W. Paxson Co., 1021 North Delaware Ave., Philadelphia, Penn., $1450; J. S. McCormick Co., 25th and A. V. R. R., Pittsburgh, Penn., $6540.

Schedule No. 5186½, Class 855, (Item 1) —one 14 in., single geared (independent motor driven) shaper, crank at least 14 x 14¾ x 18 in., delivery Supply Depot, New York City, from Fairbanks Co., Colorado Bldg., Wash., D. C., $595; Hollingsworth Machine Tool Co., Covington, Ky., $1085; Kemp Machine Co., 223 North Calvert St., Baltimore, Md., $1348, $1352, $1261; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., $605; Niles, Bement & Pond, 111 Broadway, New York City, $715.

Schedule No. 5257½, Class 861, (Item 1) —1 stationary head swind, 12 in. radius, drill press, to take drills up to 1½ in. to be fitted with spindles for belt, delivery Supply Depot, New York City, from Fairbanks Co., Colorado Bldg., Wash., D. C., $310, $395; Hoefer Manufacturing Co., 155 Chicago St., Freeport, Ill., $373.

Schedule No. 5269½, Class 884, (Item 1) —1 matcher and moulder, woodworking planer, delivery Naval Ammunition Depot, Mare Island, Calif., from American Woodworking Co., 591 Lyell Ave., Rochester, N. Y., $1716; J. A. Fay & Egan, John and Front St., Cincinnati, Ohio, $2408; Kemp Machine Co., 223 North Calvert St., Baltimore, Md., $2172; Manning, Maxwell & Moore, Inc., 119 West 40th St., New York City, $2638; Newman Machine Co., Greenville, N. C., $1895; P. B. Yates Machine Co., Beloit, Wis., $3871; Hall & Brown Woodworking Machine Co., 1913 North Broadway, St. Louis, Mo., $2798, $2248.

Schedule No. 5271½, Class 909, (Item 1) —twelve 14 in., single spindle, drill presses, with counter shafts; Class 911, (Item 3) three 16 in. with 6 ft. bed engine lathes, delivery f.o.b. works, from Cleveland Machinery and Supply Co., Cleveland National Bank Bldg., Cleveland, Ohio, (1) $262, (3) $1266; Fairbanks Co., Colorado Bldg., Wash., D. C., (1) $75; Henry & Wright Manufaccuring Co., 760 Windsor St., Hartford, Conn., (1) $250; Hoefer Manufacturing Co., 155 Chicago St., Freeport, Ill., (1) $97; Kemp Machine Co., 223 North Calvert St., Baltimore, Md., (1) $72, (3) $1383, $777; Manning, Maxwell & Moore, Inc., 119 West 40th St., New York City, (1) $100, (3) $1311; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., (1) $48, $70, $81; (3) $725, $1085; Royersford Foundry and Machine Co., 52 North 5th St., Philadelphia, Penn., (1) $39; Swind Machine Co., Widener Bldg., Philadelphia, Penn., (1) $230, (3) $1275; Edwin L. Stringer, Calvert and 31st St., Baltimore, Md., (1) $42, $35, (3) $995, $1050; Vandyck Churchill Co., 91 Liberty St., New York City, (1) $55; Champion Tool Co., Spring Grove St., Cincinnati, Ohio, (3) $1234; Cincinnati Tool and Lathe Co., North St., Cincinnati, Ohio, (3) $966; Monarch Tool Co., Sidney, Ohio, (3) $731; Niles, Bement & Pond, 111 Broadway, New York City, (3) $1210; Kahn-Harmon Co., Cincinnati, Ohio, (3) $1228; Phillip-Smith Manufacturing Co., Sidney, Ohio, (3) $835; Whitcomb-Blaisdell Machine Tool Co., 134 Gold St., Worcester, Mass., (3) $1315.

Schedule No. 4936½, Class 28, (Item 1) —4 single end, heavy work, 54 in. throat, convertible, vertical punches; Class 29, (Item 1)—1 angle, double, 8 x 8 x 1 in. angles, machine shear; Class 30, (Item 1) 2 angle, double, 6 x 6 x 1 in. angles, machine shear; Class 31, (Item 1)—1 vertical, single, end, plain jaw, flush front, 12 in. throat, motor driven rivet shear machine; Class 32, (Item 1)—2 vertical, single end, general work, 24 in. throat, angle punch machines; Class 33 (Item 1) —3 rapid action, single end, vertical angle punch machines; Class 34, (Item 1)—2 double head, 1¼ in., bolt threading machines; Class 36, (Item 1)—2 general work, 20 in. throat, single end, horizontal, angle punch machines; delivery Navy Yard, Philadelphia, Penn., from Bertsch & Co., Cambridge City, Ind., (28) $7470, (31) $2350, (32) $3455, (33) $3380; Hilles & Jones Co., 9th and Church St., Wilmington, Del., (28) $8813, (29) $13.133, (30) $8958, (31) $4045, (32) $4858, (33) $4954, (36) $5561; Manning, Maxwell & Moore, Inc., 119 West 40th St., New York City, (28) $8766, (30) $6207, (32) $3719, (34) $2228, (36) $4631; Niles, Bement & Pond, 111 Broadway, New York City, (28) $7150, (29) $9600, (30) $8180, (32) $3719, (33) $3500, (36) $4085; Williams White & Co., 3rd Ave. and 8th St., Moline, Ill., (29) $8300, (30) $5575, (32) $3150, (33) $3215, (36) $4050; Landis Machine Co., Waynesboro, Penn., (34) $2165.

Schedule No. 4953½, Class 621, (Item 1) —3 shaping machines; Class 622, (Item 1) —12 motor driven, single spindle, sensitive, drill presses; Class 623, (Item 1)—1 heavy duty, triple geared, engine lathe; Class 624, (Item 1)—1 motor driven, hand planer and jointer machine; Class 625, (Item 1) 5 universal, cutter and reamer grinding machines; Class 626, (Item 1)—2 vertical, surface, grinding machines; Class 627, (Item 1)—1 motor driven, four-side, molding machine; Class 628, (Item 1)—2 electrically driven, single cylinder, surfacing machines; Class 629, (Item 1)—1 wood, milling machine; Class 630, (Item 1)— 2 motor driven variety, bench saws; Class 631, (Item 1)—1 band, motor driven, 38 in. wheel, sawing machine; Class 632, (Item 1)—6 motor driven, portable disc sanders; Class 633 (Item 1)—1 motor driven, combination lathe with tailstock; Class 635, (Item 1)—1 motor driven, 42 in. wheel, band saw machine; Class 636, (Item 1)—2 electrically driven, hand planing and jointing machines; Class 637, (Item 1)—1 medium, vertical, boring machine; Class 638, (Item 1)—1 motor driven, combination lathe without tailstock; Class 639, (Item 1)—6 surface grinding machines; Class 640, (Item 1)—1 motor driven variety bench saw; Class 644, (Iitem 1)— 6 motor driven, speed lathes; Class 645, (Item 1)—2 motor driven, floor type, tool grinders; Class 646, (Item 1)—2 motor driven, twist drill grinders, (Item 1a)— 2 motor driven, twist drill grinders, complete with counter shaft; Class 647, (Item 1)—2 universal, cutter and reamer, grinder machines; Class 648, (Item 1)—10 electrically driven, water grinders; Class 649, (Item 1)—4 wet, tool grinding grinders; from Hollingsworth Machine Tool Co., Covington, Ky., (621) $1085, alternate $1210;